

# **Alberta Regeneration Survey Manual**

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## Notes

# 1.0 INTRODUCTION

## 1.1 General

In 1991, the legislative requirements for forest regeneration were amended to reflect an improved understanding and increased forest industry accountability for reforestation. At that time, a commitment was made to review the application and applicability of the new Alberta reforestation standard. The standards presented in this manual are the result of that review, which concluded in March, 2000. They were prepared based on the recommendations of a Regeneration Survey Task Force consisting of both industry and government practitioners, and are referred to as the **2000 Regeneration Standards**.

The purpose of the 2000 Regeneration Standards is to ensure:

- Prompt reforestation following harvest
- Adequate stocking, survival and growth rates
- A level of performance that emulates natural yields found in Alberta's forests

Alberta's reforestation standards are expressed as measurable criteria that assess if forest establishment and performance objectives have been met. This manual provides the regeneration standards and survey procedures that are to be used to determine levels of regrowth and performance of desirable tree species on harvested or otherwise denuded forested lands.

### 1.1.1 Organization of the Manual

A surveyor deals with one standard for a cutblock, depending on the years since harvest (Establishment or Performance) and the strata standard (C, CD, DC, or D) as described in Section 1.2. The manual is, therefore, organized so that all the information on strata standards for the particular survey, is located in a single section. The Wet, Low Density Standard is included separately in Section 4.0.

The field procedures and administrative requirements, which are common to all surveys, are detailed in Sections 5.0 through 7.0. Section 8.0 provides the acknowledgements. The Appendix includes a glossary, additional detail on procedures, as well as some forms and examples.

## 1.2 Strata Standards

The 2000 Regeneration Standards continue to incorporate density, height and "Free-to-Grow" status (see Glossary and Section 3.0), as well as a minimum stocking standard. Under these updated standards, forest operators will be expected to reforest to one of four "strata standards". These strata standards are: Coniferous (C), Coniferous-Deciduous (CD), Deciduous-Coniferous (DC) and Deciduous (D).

## 1.3 Types of Surveys

### 1.3.1 Establishment and Performance Surveys

The 2000 Regeneration Standards utilize two independent surveys with timelines for delivery as follows:

1. an Establishment Survey completed 4 to 8 years after harvesting in C, CD and DC cutblocks; and 3 to 5 years after harvesting in D cutblocks.
2. a Performance Survey completed 8 to 14 years after harvesting in C, CD and DC cutblocks, and 10 to 14 years after harvesting in conditionally stocked D cutblocks.

The Establishment Survey will show stocking amount (percent), density (stems/ha) and early growth (height and diameter) of regenerated trees, as well as the approximate locations of satisfactorily restocked (SR) and/or not satisfactorily restocked (NSR) areas larger than 4 ha.

The Performance Survey will measure the same variables as the Establishment Survey, however, to different standards, and in addition will identify coniferous crop trees deemed to be Free-to-Grow or else in need of stand cleaning.

## 1.4 Applicability

Regeneration surveys conducted on all public lands within the Province of Alberta for the purpose of fulfilling obligations under the Timber Management Regulation are to be carried out according to procedures provided in this manual unless otherwise specified by the Minister of Alberta Environment. Details on related policies and aspects of enforcement may be described in directives posted or otherwise distributed by Alberta Environment.

This manual is effective as of May 1, 2000.

1. Cutblocks created after April 30, 2000 will be subject to the 2000 Regeneration Standards as detailed in this manual. These new blocks will be declared by the forest operator to a strata standard, where:
  - a. the area declared to each strata standard is balanced annually with the area cut in each of the standing timber strata, and,
  - b. current detailed forest management plan regenerated yield assumptions are followed.
2. Cutblocks which were created after March 1, 1991 but before May 1, 2000 are subject to the 2000 Regeneration Standards as follows:
  - a. All stands harvested are to be assigned to one of the new strata standards. (See Section 1.4.1)
  - b. If the cutblock has been surveyed and has been declared Not Satisfactorily Restocked (NSR), the forest operator responsible for reforestation must declare the cutblock under one of the four strata standards: C, CD, DC or D. The cutblock would then be required to pass the Establishment and Performance Surveys of the 2000 Regeneration Standards for the strata category declared.
  - c. If the cutblock has not been surveyed, the forest operator responsible for reforestation must declare the cutblock under one of the four strata standards: C, CD, DC or D. The cutblock would then be required to pass the Establishment and Performance Survey of the 2000 Regeneration Standards for the strata category declared.
  - d. If the cutblock has been surveyed to the Establishment Survey of the 1991 Regeneration Standards, and declared Satisfactorily Restocked (SR), the forest operator responsible for reforestation must declare the cutblock under one of the four strata standards: C, CD, DC or D. The cutblock would then be required to pass the Performance Survey of the 2000 Regeneration Standards.

### 1.4.1 Re-classification of Strata Standard

The original strata standard declared for a cutblock cut after May 1, 2000, can be changed if an equivalent area is assigned to meet the original strata standard. This "swapping" of cutblocks is termed re-classification, and provides the opportunity to maximize efficiency of treatments. Re-classified areas must be +/- 5% in area and be no more than five years different in age. Re-classification applies only to cutblocks in the same sustained-yield unit, and, can apply to blocks managed by different disposition holders in the unit, if there is agreement on the re-classifications. Re-classification can take place at any time, up to the completion of the performance survey.

All cutblocks cut since March 1, 1991 but before May 1, 2000 are re-classified to one of the new strata standards. Areas harvested since March 1, 1991 but before May 1, 2000 will be re-classified in a manner consistent with Section 1.4 (1). Mixed wood stands that have been treated to meet the C standard in such manner that the deciduous component of the stand has been reduced to the point where the mixed wood standard cannot be met, may be re-classified to the new C strata standard.

Cutblocks which have been accepted as Lowland modifier under the 1991 Regeneration Standards do not automatically fall under the new Wet, Low density modifier of the 2000 Regeneration Standards.



Cutblocks to be re-classified as the Wet, Low density modifier must meet the criteria provided in Section 4.0. Where a Lowland modifier cutblock does not meet the criteria for Wet, low density modifier, the reduced height potential is now addressed through species, Natural subregion and ecosite-specific height standards in the 2000 Regeneration Survey Standards.

Cutblocks which have been accepted as **High Elevation modifier cutblocks** as per the 1991 Reforestation Standards are now addressed through species, Natural subregion and ecosite-specific height standards in the 2000 Regeneration Survey Standards.

The Annual Silviculture Plan will detail the re-classification of all of the cutblocks harvested since March 1, 1991 but before May 1, 2000.

#### **1.4.2 Re-designation of Strata Standard**

Re-classification after a performance survey can include swapping with cutblocks with a completed performance survey. Where a cutblock does not meet the assigned strata standard, and re-classification is not feasible, the cutblock must be **re-designated** to the appropriate strata standard and the annual allowable cut adjusted. All re-classifications and re-designations must be approved through the Annual Operating Plan process, specifically in the Annual Silviculture Plan.

#### **1.4.3 Alternative Survey Standards and Methods**

Notwithstanding the standards presented in this manual, alternative regeneration standards may be used where approved by the Land and Forest Service. The forest operator must receive approval before employing survey **methods** that are contrary to those described in this manual. For example, the Alberta regeneration survey may be conducted using aerial photography and follow up ground truthing, provided the methodologies and specifications are approved by the Forest Area Manager.

**Greater detail regarding Section 1.4 will be provided in directives posted or otherwise communicated by the Land and Forest Service.**

### **1.5 Authority**

Regeneration surveys are required to be conducted under the authority of the Timber Management Regulation, Part 6 Reforestation, specifically Section 141.2. Timing and delivery of surveys is also specified in the Timber Management Regulation.

### **1.6 Qualifications of Surveyors**

Under the authority of Section 141.3 of the Timber Management Regulation, the Minister requires that in order for a regeneration survey to be acceptable, a **certified regeneration surveyor** must be the principle participant in the field survey.

A certified regeneration surveyor is a person who:

1. has successfully completed the current government sanctioned training course(s), and
2. has met the field experience requirement of satisfactory **principle participation** in five (5) field surveys, and
3. has received a certification number, and
4. the certification is valid at the time of survey.

In order to be considered a **principle participant** in the field survey, the certified surveyor must:

1. establish the control line, and
2. establish all plots or conduct quality check plots on a minimum of 10% of the plots in the cutblock, and
3. certify the accuracy and completeness of the survey by entering the certification number on the survey form.

## 2.2 Coniferous-Deciduous Standard (CD)

### 2.2.1 Timing of Survey

The Establishment Survey must be carried out no sooner than 4 years and no later than 8 years after harvesting is completed.

### 2.2.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one acceptable established crop tree which meets the species and height parameters defined below.

A cutblock being reforested to a coniferous-deciduous (CD) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 2.4:

TABLE 2.4

| Cutblock  | Minimum Conifer Stocking* | Minimum Deciduous Stocking* | Minimum Total Stocking |
|---|---------------------------|-----------------------------|------------------------|
| Areas harvested March 1, 1991 to April 30, 2000 | 50%                       | 10%                         | 80%                    |
| Areas harvested after May 1, 2000               | 50%                       | 30%                         | 80%                    |

\*The assessment of the minimum stocking of the deciduous species is independent of the presence of coniferous trees on the plot. Where both species groups are represented, this is referred to as an overlapping plot.

### 2.2.3 Acceptable Established Crop Trees

Both acceptable established seedlings and acceptable advanced growth are considered acceptable established crop trees.

An **acceptable established seedling** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for a minimum of three years.

**Acceptable advanced growth** is a specific tree of acceptable species which was established in advance of the harvest, meets the minimum height requirement and which also has the following characteristics:

1. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the established crop trees are harvested, and
2. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base, and
3. The tree originated from seed or suckering, but not from layering, and
4. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.

### 2.2.3.1 Acceptable crop tree species

Table 2.5 details the crop tree species which are acceptable for established seedlings and advanced growth on areas being reforested to a coniferous-deciduous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Service.

TABLE 2.5

Acceptable crop tree species including advanced growth on areas being reforested to a coniferous-deciduous standard.

| Coniferous species | Deciduous species     |
|--------------------|-----------------------|
| White spruce       | Trembling aspen       |
| Englemann spruce   | Balsam (Black) poplar |
| Black spruce       | Hybrid Poplar *       |
| Lodgepole pine     | White (Paper) birch   |
| Jack pine          |                       |
| Whitebark pine     |                       |
| Limber pine        |                       |
| Tamarack           |                       |
| Western larch      |                       |
| Alpine larch       |                       |
| Siberian larch*    |                       |
| Douglas-fir        |                       |

\* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in and approved Detailed Forest Management Plan (DFMP)

Balsam fir and Subalpine fir may be considered acceptable species for specific cutblocks when either:

- fir has been identified specifically in the DFMP and a management strategy has been developed for its use and expected yield; or
- fir has been identified as being a species in the overstory that was harvested. This would be applied on a block-by-block basis and must be presented in pre-harvest plans; or
- when approval is received from the Forest Area Manager to allow it to be used as an acceptable species for resource management objectives other than fibre production on a specific cutblock basis.

The amount of fir which is acceptable on a block by block basis is determined prior to the survey. Greater detail regarding acceptability of fir will be provided in directives posted or otherwise communicated by the Land and Forest Service.

### 2.2.3.2 Acceptable crop tree height

Table 2.6 details the minimum height requirements for an acceptable established crop tree on areas being reforested to a coniferous-deciduous standard.

TABLE 2.6

Crop tree establishment height requirements for areas being reforested to a coniferous-deciduous standard.

| Sub-region   | Minimum conifer crop tree height (cm) | Minimum deciduous crop tree height (cm) |
|--|---------------------------------------|---|
| Central Mixedwood<br>Boreal Highlands<br>Dry Mixedwood<br>Wetland Mixedwood<br>Lower Foothills | 30                                    | 120                                     |
| Subalpine, Montane, &<br>Upper Foothills   | 30                                    | 80                                      |

## 2.3 Deciduous-Coniferous Standard (DC)

### 2.3.1 Timing of Survey

The Establishment Survey must be carried out no sooner than 4 years and no later than 8 years after harvesting is completed.

### 2.3.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one acceptable established crop tree which meets the species and height parameters as defined below.

A cutblock being reforested to a deciduous-coniferous (DC) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 2.7:

TABLE 2.7

| Cutblock  | Minimum Conifer Stocking | Minimum Deciduous Stocking* | Minimum Total Stocking |
|---|--------------------------|-----------------------------|------------------------|
| Areas harvested March 1, 1991 to April 30, 2000 | 30%                      | 30%                         | 80%                    |
| Areas harvested after May 1, 2000               | 30%                      | 50%                         | 80%                    |

\*The assessment of the minimum stocking of the deciduous species is independent of the presence of coniferous trees on the plot. Where both species groups are represented, this is referred to as an overlapping plot.

### 2.3.3 Acceptable Established Crop Trees

Both acceptable established seedlings and acceptable advanced growth are considered acceptable established crop trees.

An **acceptable established seedling** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for a minimum of three years.

**Acceptable advanced growth** is a specific tree of acceptable species which was established in advance of the harvest, meets the minimum height requirement and which also has the following characteristics:

1. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the established crop trees are harvested, and
2. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base, and
3. The tree originated from seed or suckering, but not from layering, and
4. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.

### 2.3.3.1 Acceptable crop tree species

Table 2.8 details the crop tree species which are acceptable for established seedlings and advanced growth on areas being reforested to a deciduous-coniferous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Service.

TABLE 2.8  
Acceptable crop tree species including advanced growth  
for areas being reforested to a deciduous-coniferous standard.

| Coniferous species | Deciduous species     |
|--------------------|-----------------------|
| White spruce       | Trembling aspen       |
| Englemann spruce   | Balsam (Black) poplar |
| Black spruce       | Hybrid Poplar *       |
| Lodgepole pine     | White (Paper) birch   |
| Jack pine          |                       |
| Whitebark pine     |                       |
| Limber pine        |                       |
| Tamarack           |                       |
| Western larch      |                       |
| Alpine larch       |                       |
| Siberian larch*    |                       |
| Douglas-fir        |                       |

\* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP)

Balsam fir and Subalpine fir may be considered acceptable species for specific cutblocks when either:

- fir has been identified specifically in the DFMP and a management strategy has been developed for its use and expected yield; or
- fir has been identified as being a species in the overstory that was harvested. This would be applied on a block-by-block basis and must be presented in pre-harvest plans; or
- when approval is received from the Forest Area Manager to allow it to be used as an acceptable species for resource management objectives other than fibre production on a specific cutblock basis.

The amount of fir which is acceptable on a block by block basis is determined prior to the survey. Greater detail regarding acceptability of fir will be provided in directives posted or otherwise communicated by the Land and Forest Service.

### 2.3.3.2 Acceptable crop tree height

Table 2.9 details the minimum establishment height requirements for an acceptable crop tree on areas being reforested to a deciduous-coniferous standard.

TABLE 2.9  
Crop tree establishment height requirements  
for areas being reforested to a deciduous-coniferous standard.

| Sub-region   | Minimum conifer<br>crop tree height (cm) | Minimum deciduous crop<br>tree height (cm) |
|--|--|--|
| Central Mixedwood<br>Dry Mixedwood<br>Wetland Mixedwood<br>Boreal Highlands<br>Lower Foothills | 30                                       | 120  |
| Subalpine, Montane, &<br>Upper Foothills   | 30                                       | 80   |

## 2.4 Deciduous Standard (D)

### 2.4.1 Timing of Survey

The Establishment Survey must be carried out no sooner than 3 years and no later than 5 years after harvesting is completed.

### 2.4.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one acceptable established crop tree, or at least one conditional coniferous tree which meets the species and height parameters as defined below.

#### 2.4.2.1 Satisfactorily restocked areas

A cutblock that is to be reforested to a deciduous standard will be considered **satisfactorily restocked** when:

- 80% or more of the sample plots are stocked with at least one acceptable or one conditional established crop tree and at least 60% are stocked with at least one acceptable established deciduous tree (as outlined in Table 2.10), and
- The portion of plots stocked with conditional coniferous trees does not exceed 20 %, and
- The average number of acceptable deciduous trees per plot on the cutblock must be equal to or greater than the average number of acceptable deciduous trees by sub-region and drainage class (Table 2.12), and the minimum average height of acceptable deciduous trees is met (Table 2.12).

TABLE 2.10

| Cutblock  | Minimum Conifer Stocking | Minimum Deciduous Stocking | Minimum Total Stocking* |
|---|--------------------------|----------------------------|-------------------------|
| Areas harvested March 1, 1991 to April 30, 2000 | 0%                       | 60%                        | 80%                     |
| Areas harvested after May 1, 2000               | 0%                       | 60%                        | 80%                     |

\*The portion of plots stocked with conditional coniferous trees may not exceed 20% for SR blocks.

#### 2.4.2.2 Conditionally restocked areas

An area which is to be reforested to deciduous standards will be considered **conditionally restocked** when, according to the definitions below, there are either:

##### a. Low average number of acceptable deciduous trees:

- 80% or more of the sample plots are stocked with at least one acceptable tree, and
- the average height of acceptable deciduous trees on the cutblock is greater than or equal to the average height of acceptable deciduous trees by subregion, ecosite and drainage class (Table 2.12), and
- the average number of acceptable deciduous trees per plot on the cutblock is less than the average number of acceptable deciduous trees by subregion, ecosite and drainage class (Table 2.12).

OR

##### b. Greater than 20% conditional conifer trees:

- 80% or more of the sample plots are stocked with at least one acceptable or at least one conditional coniferous tree. The portion of plots stocked with conditional coniferous trees exceeds 20%, and
- the average height of acceptable deciduous trees on the cutblock is greater than or equal to the average height of acceptable deciduous trees by subregion, ecosite and drainage class (Table 2.12), and

- the average number of acceptable deciduous trees per plot on the cutblock is greater than or equal to the average number of acceptable deciduous trees by subregion, ecosite and drainage (Table 2.12).

OR

- c. Low average number of acceptable deciduous trees and more than 20% conditional conifer trees:
  - 80% or more of the sample plots are stocked with at least one acceptable tree or at least one conditional coniferous tree. The portion of plots stocked with conditional coniferous trees exceeds 20%, and
  - the average height of acceptable deciduous trees on the cutblock is greater than or equal to the average height of acceptable deciduous trees by subregion, ecosite and drainage class (Table 2.12), and
  - the average number of acceptable deciduous trees per plot on the cutblock is less than the average number of acceptable deciduous trees by subregion, ecosite and drainage class (Table 2.12).

Conditionally restocked areas are subject to a deciduous performance survey (Section 3.4).

## 2.4.3 Acceptable Established Crop Trees

### 2.4.3.1 *Acceptable crop tree species*

Table 2.11 details the crop tree species which are acceptable for established seedlings and advanced growth on areas being reforested to a deciduous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Service.

TABLE 2.11  
Acceptable crop tree species including advanced growth  
for areas being reforested to a deciduous standard.

| Coniferous species | Deciduous species     |
|--------------------|-----------------------|
| White spruce       | Trembling aspen       |
| Englemann spruce   | Balsam (Black) poplar |
| Black spruce       | Hybrid Poplar *       |
| Lodgepole pine     | White (Paper) birch   |
| Jack pine          |                       |
| Whitebark pine     |                       |
| Limber pine        |                       |
| Tamarack           |                       |
| Western larch      |                       |
| Alpine larch       |                       |
| Siberian larch*    |                       |
| Douglas-fir        |                       |

\* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP)

Balsam fir and Subalpine fir may be considered acceptable species for specific cutblocks when either:

- a. fir has been identified specifically in the DFMP and a management strategy has been developed for its use and expected yield; or
- b. fir has been identified as being a species in the overstory that was harvested. This would be applied on a block-by-block basis and must be presented in pre-harvest plans; or
- c. when approval is received from the Forest Area Manager to allow it to be used as an acceptable species for resource management objectives other than fibre production on a specific cutblock basis.

The amount of fir which is acceptable on a block by block basis is determined prior to the survey. Greater detail regarding acceptability of fir will be provided in directives posted or otherwise communicated by the Land and Forest Service.

#### **2.4.3.2     *Characteristics of acceptable crop trees***

An **acceptable crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement specified in Table 2.12, is alive, healthy and undamaged, and has grown on-site for a minimum of three years. Coniferous trees must not have more than two stems at the base.

#### **2.4.3.3     *Characteristics of conditional coniferous trees***

A **conditional conifer tree** is a specific tree of acceptable species which has achieved the minimum height requirement specified in Table 2.12 for conditional coniferous trees but has not achieved the minimum crop tree height. It is alive, healthy and undamaged, and has grown on-site for a minimum of three years.



Table 2.12 provides the minimum heights and numbers of trees for various species groups and sites as required to meet deciduous establishment standards.

TABLE 2.12  
Crop tree height and density requirements for areas  
being reforested to a deciduous establishment standard.

| Natural Sub-region                                  | Species            | Drainage Class   | Ecosite*   | Minimum crop tree height (cm) | Minimum average height of acceptable deciduous trees ** | Minimum average number of acceptable deciduous per plot *** | Minimum height of conditional coniferous trees |
|---|--------------------|------------------|------------|-------------------------------|---|---|--|
| Central Mixedwood<br>Dry Mixedwood<br>Wet Mixedwood | Sw, Sb, Fb, Fa     | VR, R, W, MW & I | A-E        | 80                            | n/a   | n/a   | 30   |
|   |                    | P & VP           | F-H        | 80                            | n/a   | n/a   | 30   |
|   | Pl, Pj, Li         | VR, R, W, MW & I | A-E        | 160                           | n/a   | n/a   | 60   |
|   |                    | P & VP           | F-H        | 160                           | n/a   | n/a   | 60   |
|   | Aw, Pb, Bw         | VR, R, W, MW & I | A-E        | 80                            | 160   | 7.0   | n/a  |
|   |                    | P & VP           | F-H        | 80                            | 120   | 5.0   | n/a  |
| Boreal Highlands                                    | Sw, Sb, Fb, Fa     | VR, R, W, MW & I | A-E        | 80                            | n/a   | n/a   | 30   |
|   |                    | P & VP           | F-G        | 80                            | n/a   | n/a   | 30   |
|   | Pl, Pj, Li         | VR, R, W, MW & I | A-E        | 160                           | n/a   | n/a   | 60   |
|   |                    | P & VP           | F-G        | 160                           | n/a   | n/a   | 60   |
|   | Aw, Pb, Bw         | VR, R, W, MW & I | A-E        | 80                            | 160   | 7.0   | n/a  |
|   |                    | P & VP           | F-G        | 80                            | 120   | 5.0   | n/a  |
| Montane   | Sw, Se, Sb, Fd, Fa | VR, R, W, MW & I | A-E, (A-F) | 80                            | n/a   | n/a   | 30   |
|   |                    | P & VP           | F-G, (G)   | 80                            | n/a   | n/a   | 30   |
|   | Pt, Pl, La         | VR, R, W, MW & I | A-E, (A-F) | 160                           | n/a   | n/a   | 60   |
|   |                    | P & VP           | F-G, (G)   | 160                           | n/a   | n/a   | 60   |
|   | Aw, Pb, Bw         | VR, R, W, MW & I | A-E, (A-F) | 50                            | 100   | 7.0   | n/a  |
|   |                    | P & VP           | F-G, (G)   | 50                            | 75  | 5.0   | n/a  |
| Lower Foothills                                     | Sw, Sb, Fb, Fa     | VR, R, W, MW & I | A-E        | 80                            | n/a   | n/a   | 30   |
|   |                    | P & VP           | F-H        | 80                            | n/a   | n/a   | 30   |
|   | Pl, Li             | VR, R, W, MW & I | A-E        | 160                           | n/a   | n/a   | 60   |
|   |                    | P & VP           | F-H        | 160                           | n/a   | n/a   | 60   |
|   | Aw, Pb, Bw         | VR, R, W, MW & I | A-E        | 80                            | 140   | 7.0   | n/a  |
|   |                    | P & VP           | F-H        | 80                            | 100   | 5.0   | n/a  |

TABLE 2.12 (Continued)

Crop tree height and density requirements for areas  
being reforested to a deciduous establishment standard.

| Natural Sub-region  | Species         | Drainage Class   | Ecosite*   | Minimum crop tree height (cm) | Minimum average height of acceptable deciduous trees ** | Minimum average number of acceptable deciduous trees per plot *** | Minimum height of conditional coniferous trees |
|---------------------|-----------------|------------------|------------|-------------------------------|---|---|--|
| Upper Foothills**** | Sw, Se, Sb, Fa. | VR, R, W, MW & I | A-F, (A-E) | 80                            | n/a   | n/a   | 30   |
|                     |                 | P & VP           | G-J (F-H)  | 80                            | n/a   | n/a   | 30   |
|                     | Pl, Li          | VR, R, W, MW & I | A-F, (A-E) | 160                           | n/a   | n/a   | 60   |
|                     |                 | P & VP           | G-J (F-H)  | 160                           | n/a   | n/a   | 60   |
|                     | Aw, Pb, Bw      | VR, R, W, MW & I | A-F, (A-E) | 50                            | 100   | 7.0   | n/a  |
|                     |                 | P & VP           | G-J (F-H)  | 50                            | 75  | 5.0   | n/a  |

\* Ecosites in brackets are from the Field Guide to Ecosites of South Western Alberta, whereas the other ecosites are from the Field Guide to Ecosites of West Central Alberta and the Field Guide to Ecosites of Northern Alberta for the appropriate Natural Subregions. THESE ARE DETERMINED BEFORE HARVEST ONLY.

\*\* The average height of acceptable deciduous trees is the arithmetic mean of the tallest deciduous tree from each plot in the cutblock stocked to deciduous species, excluding advanced growth and those plots contributing to the declared conifer stocking percentage.

\*\*\* The average number of acceptable deciduous trees is the arithmetic mean of the number of acceptable deciduous trees from all plots (deciduous and silvally plots), excluding those plots that are stocked to coniferous trees. In each stocked plot, the maximum number of acceptable deciduous trees that may be used in the calculation is 10.

\*\*\*\* In the Upper Foothills Subregion the deciduous strata standard will only be allowed where the previous stand type was DC or D.

### 3.0

## PERFORMANCE SURVEY STANDARDS

### 3.1 Coniferous Standard (C)

#### 3.1.1 Timing of Survey

The Performance Survey must be carried out no sooner than 8 years and no later than 14 years after harvesting is completed.

#### 3.1.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one acceptable crop tree which meets the species, height and other characteristics as defined below.

A cutblock being reforested to a coniferous (C) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 3.1:

TABLE 3.1

| Cutblock  | Minimum Conifer Stocking | Minimum Deciduous Stocking | Minimum Total Cutblock Stocking |
|---|--------------------------|----------------------------|---------------------------------|
| Areas harvested March 1, 1991 to April 30, 2000   | 70%                      | 0%                         | 80%                             |
| Areas harvested after May 1, 2000 in Subalpine, Montane, & Upper Foothills  | 80%                      | 0%                         | 80%                             |
| Areas harvested after May 1, 2000 in Lower Foothills, Central Mixedwood, Dry Mixedwood, Wetland Mixedwood Boreal Highlands. | 70%                      | 0%                         | 80%                             |

### 3.1.3 Acceptable Crop Trees

Acceptable Free-to-Grow seedlings, performing deciduous trees, and acceptable Free-to-Grow advanced growth are considered acceptable crop trees.

An acceptable Free-to-Grow seedling is a tree of acceptable coniferous species which has achieved the minimum height requirement specified in Table 3.3, is alive, healthy and undamaged, and has grown on-site for a minimum of three years. In order to be considered Free-to-Grow, it must be located at least 2m distance from any deciduous tree (other than residual deciduous trees) which is taller than two-thirds its height or any shrub which is taller than two-thirds its height.

| Species                | Free-to-Grow Cylinder Size | Area within cylinder free of competitor trees                               |
|------------------------|----------------------------|---|
| Spruces, larches, firs | 2.0 m radius               | Free of competitor trees/shrubs within entire cylinder around the crop tree |
| Pines                  | 2.0 m radius               | Free of competitor trees/shrubs within entire cylinder around the crop tree |

A performing deciduous tree is a tree of acceptable species which has achieved the minimum height requirement specified in Table 3.4, is alive, healthy and undamaged, and has grown on-site for a minimum of three years. There is no requirement for a competition-free cylinder for the deciduous species.

Acceptable Free-to-Grow advanced growth is a specific tree of acceptable species which was established in advance of the harvest, meets the minimum height requirement specified in Table 3.3 or Table 3.4, and which also has the following characteristics:

1. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the established crop trees are harvested.
2. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base.
3. The tree originated from seed or suckering, but not from layering.
4. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.
5. The tree meets the species-specific definition of Free-to-Grow

### 3.1.3.1 Acceptable crop tree species

Table 3.2 details the crop tree species which are acceptable on areas being reforested to a coniferous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Service.

TABLE 3.2  
Acceptable crop tree species including advanced growth  
for areas being reforested to a coniferous standard.

| Coniferous species | Deciduous species     |
|--------------------|-----------------------|
| White spruce       | Trembling aspen       |
| Englemann spruce   | Balsam (Black) poplar |
| Black spruce       | Hybrid Poplar *       |
| Lodgepole pine     | White (Paper) birch   |
| Jack pine          |                       |
| Whitebark pine     |                       |
| Limber pine        |                       |
| Tamarack           |                       |
| Western larch      |                       |
| Alpine larch       |                       |
| Siberian larch*    |                       |
| Douglas-fir        |                       |

\* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP)

Balsam fir and Subalpine fir may be considered acceptable species for specific cutblocks when either:

- fir has been identified specifically in the DFMP and a management strategy has been developed for its use and expected yield; or
- fir has been identified as being a species in the overstory that was harvested. This would be applied on a block-by-block basis and must be presented in pre-harvest plans; or
- when approval is received from the Forest Area Manager to allow it to be used as an acceptable species for resource management objectives other than fibre production on a specific cutblock basis.

The amount of fir which is acceptable on a block by block basis is determined prior to the survey. Greater detail regarding acceptability of fir will be provided in directives posted or otherwise communicated by the Land and Forest Service.

TABLE 3.3 (Continued)

| Sub-region<br>(South of the North<br>Saskatchewan River) | Species        | Drainage<br>Class | Ecosite      | Minimum crop<br>tree height (cm) |
|--|----------------|-------------------|--------------|----------------------------------|
| Lower Foothills  | Pl, Li         | VR, R, W, MW & I  | A-F<br>(A-E) | 100                              |
|  |                | P to VP           | G-J<br>(F-H) | 85                               |
|  | Sb, Fa, Fb     | VR, R, W, MW & I  | A-F<br>(A-E) | 55                               |
|  |                | P to VP           | G-J<br>(F-H) | 45                               |
|  | Sw             | VR, R, W, MW & I  | A-F<br>(A-E) | 75                               |
|  |                | P to VP           | G-J<br>(F-H) | 65                               |
| Upper Foothills  | Pl, Li         | VR, R, W, MW & I  | A-F<br>(A-E) | 80                               |
|  |                | P to VP           | G-J<br>(F-H) | 70                               |
|  | Sb, Fa         | VR, R, W, MW & I  | A-F<br>(A-E) | 55                               |
|  |                | P to VP           | G-J<br>(F-H) | 40                               |
|  | Sw             | VR, R, W, MW & I  | A-F<br>(A-E) | 70                               |
|  |                | P to VP           | G-J<br>(F-H) | 60                               |
| Montane  | Pl, Pt, Li     | VR, R, W, MW & I  | A-E<br>(A-F) | 60                               |
|  |                | P to VP           | F-G<br>(G)   | 55                               |
|  | Sb, Fa         | VR, R, W, MW & I  | A-E<br>(A-F) | 45                               |
|  |                | P to VP           | F-G<br>(G)   | 35                               |
|  | Sw, Sc         | VR, R, W, MW & I  | A-E<br>(A-F) | 65                               |
|  |                | P to VP           | F-G<br>(G)   | 55                               |
|  | Fd             | VR, R, W, MW & I  | A-E<br>(A-F) | 35                               |
|  |                |                   |              |                                  |
| Subalpine  | Pl, Pw, Lt, La | VR, R, W, MW & I  | A-D<br>(A-F) | 60                               |
|  |                | P to VP           | E-I<br>(G-H) | 55                               |
|  | Sb, Fa         | VR, R, W, MW & I  | A-D<br>(A-F) | 45                               |
|  |                | P to VP           | E-I<br>(G-H) | 35                               |
|  | Sw, Sc         | VR, R, W, MW & I  | A-D<br>(A-F) | 65                               |
|  |                | P to VP           | E-I<br>(G-H) | 55                               |
|  | Fd             | VR, R, W, MW & I  | A-D<br>(A-F) | 35                               |
|  |                |                   |              |                                  |

Table 3.4 details the minimum deciduous height requirements for an acceptable crop tree on areas being reforested to a coniferous standard.

TABLE 3.4  
Deciduous crop tree performance height requirements  
for areas being reforested to a coniferous standard.

| Natural Sub-region                                  | Species    | Drainage Class   | Ecosite       | Minimum crop tree height (cm) |
|---|------------|------------------|---------------|-------------------------------|
| Central Mixedwood<br>Dry Mixedwood<br>Wet Mixedwood | Aw, Pb, Bw | VR, R, W, MW & I | A-E           | 200                           |
|   |            | P to VP          | F-H           | 150                           |
| Boreal Highlands                                    | Aw, Pb, Bw | VR, R, W, MW & I | A-E           | 200                           |
|   |            | P to VP          | F-G           | 150                           |
| Lower Foothills                                     | Aw, Pb, Bw | VR, R, W, MW & I | A-F,<br>(A-E) | 175                           |
|   |            | P to VP          | G-J,<br>(F-H) | 125                           |
| Upper Foothills                                     | Aw, Pb, Bw | VR, R, W, MW & I | A-F,<br>(A-E) | 150                           |
|   |            | P to VP          | G-J,<br>(F-H) | 115                           |
| Montane   | Aw, Pb, Bw | VR, R, W, MW & I | A-E,<br>(A-F) | 150                           |
|   |            | P to VP          | F-G,<br>(G)   | 115                           |
| Subalpine   | Aw, Pb, Bw | VR, R, W, MW & I | A-D,<br>(A-F) | 150                           |
|   |            | P to VP          | E-I,<br>(G-H) | 115                           |

## 3.2 Coniferous-Deciduous Standard (CD)

### 3.2.1 Timing of Survey

The Performance Survey must be carried out no sooner than 8 years and no later than 14 years after harvesting is completed.

### 3.2.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one acceptable crop tree which meets the species, height and other characteristics as defined below.

A cutblock being reforested to a coniferous-deciduous (CD) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 3.5:

TABLE 3.5

| Cutblock  | Minimum Conifer Stocking | Minimum Deciduous Stocking* | Minimum Total Cutblock Stocking |
|---|--------------------------|-----------------------------|---------------------------------|
| Areas harvested March 1, 1991 to April 30, 2000 | 50%                      | 10%                         | 80%                             |
| Areas harvested after May 1, 2000               | 50%                      | 30%                         | 80%                             |

\*The assessment of the minimum stocking of the deciduous species is independent of the presence of coniferous trees on the plot. Where both species groups are represented, this is referred to as an overlapping plot.

### 3.2.3 Acceptable Crop Trees

Acceptable Free-to-Grow seedlings, performing deciduous trees, and acceptable Free-to-Grow advanced growth are considered acceptable crop trees.

An acceptable Free-to-Grow seedling is a tree of acceptable coniferous species which has achieved the minimum height requirement specified in Table 3.7, is alive, healthy and undamaged, and has grown on-site for a minimum of three years. In order to be considered Free-to-Grow, it must be located at least 1.5 to 2m distance from any deciduous tree (other than residual deciduous trees) which is taller than two-thirds its height or any shrub which is taller than two-thirds its height.

| Species                | Free-to-Grow Cylinder Size | Area within cylinder free of competitor trees  |
|------------------------|----------------------------|--|
| Spruces, larches, firs | 1.5 m radius               | Free of deciduous competitor trees/shrubs throughout a 270 degree arc around the crop tree |
| Pines                  | 2.0 m radius               | Free of deciduous competitor trees/shrubs within entire cylinder around the crop tree      |

A performing deciduous tree is a tree of acceptable species which has achieved the minimum height requirement specified in Table 3.8, is alive, healthy and undamaged, and has grown on-site for a minimum of three years. There is no requirement for a competition - free cylinder for the deciduous species.



**Acceptable Free-to-Grow advanced growth** is a specific tree of acceptable species which was established in advance of the harvest, meets the minimum height requirement and which also has the following characteristics:

1. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the established crop trees are harvested.
2. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base.
3. The tree originated from seed or suckering, but not from layering.
4. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.
5. The tree meets the species-specific definition of Free-to-Grow

### 3.2.3.1 *Acceptable crop tree species*

Table 3.6 details the crop tree species which are acceptable for established seedlings and advanced growth on areas being reforested to a coniferous-deciduous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Service.

TABLE 3.6  
Acceptable crop tree species including advanced growth  
for areas being reforested to a coniferous-deciduous standard.

| Coniferous species | Deciduous species     |
|--------------------|-----------------------|
| White spruce       | Trembling aspen       |
| Englemann spruce   | Balsam (Black) poplar |
| Black spruce       | Hybrid Poplar *       |
| Lodgepole pine     | White (Paper) birch   |
| Jack pine          |                       |
| Whitebark pine     |                       |
| Limber pine        |                       |
| Tamarack           |                       |
| Western larch      |                       |
| Alpine larch       |                       |
| Siberian larch*    |                       |
| Douglas-fir        |                       |

\* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP)

Balsam fir and Subalpine fir may be considered acceptable species for specific cutblocks when either:

- a. fir has been identified specifically in the DFMP and a management strategy has been developed for its use and expected yield; or
- b. fir has been identified as being a species in the overstory that was harvested. This would be applied on a block-by-block basis and must be presented in pre-harvest plans; or
- c. when approval is received from the Forest Area Manager to allow it to be used as an acceptable species for resource management objectives other than fibre production on a specific cutblock basis.

The amount of fir which is acceptable on a block by block basis is determined prior to the survey. Greater detail regarding acceptability of fir will be provided in directives posted or otherwise communicated by the Land and Forest Service.

### 3.2.3.2 Acceptable crop tree height

Table 3.7 details the minimum conifer height requirements for an acceptable crop tree on areas being reforested to a coniferous-deciduous standard.

TABLE 3.7  
Coniferous crop tree performance height requirements  
for areas being reforested to a coniferous-deciduous standard.

| Sub-region<br>(North of the North<br>Saskatchewan River) | Species    | Drainage<br>Class | Ecosite       | Minimum crop<br>tree height (cm) |
|--|------------|-------------------|---------------|----------------------------------|
| Central Mixedwood<br>Wetland Mixedwood<br>Dry Mixedwood  | Pl, Pj, Li | VR, R, W, MW & I  | A-E           | 150                              |
|  |            | P to VP           | F-H           | 130                              |
|  | Sb, Fa, Fb | VR, R, W, MW & I  | A-E           | 75                               |
|  |            | P to VP           | F-H           | 60                               |
|  | Sw         | VR, R, W, MW & I  | A-E           | 100                              |
|  |            | P to VP           | F-H           | 80                               |
| Lower Foothills  | Pl, Li     | VR, R, W, MW & I  | A-F<br>(A-E)  | 150                              |
|  |            | P to VP           | G-J<br>(F-H)  | 130                              |
|  | Sb, Fa, Fb | VR, R, W, MW & I  | A-F<br>(A-E)  | 75                               |
|  |            | P to VP           | G-J<br>(F-H)  | 60                               |
|  | Sw         | VR, R, W, MW & I  | A-F<br>(A-E)  | 100                              |
|  |            | P to VP           | G-J<br>(F-H)  | 80                               |
| Boreal Highlands   | Pl, Pj, Li | VR, R, W, MW & I  | A-E           | 150                              |
|  |            | P to VP           | F-G           | 130                              |
|  | Sb, Fa, Fb | VR, R, W, MW & I  | A-E           | 75                               |
|  |            | P to VP           | F-G           | 60                               |
|  | Sw         | VR, R, W, MW & I  | A-E           | 100                              |
|  |            | P to VP           | F-G           | 80                               |
| Upper Foothills  | Pl, Li     | VR, R, W, MW & I  | A-F,<br>(A-E) | 125                              |
|  |            | P to VP           | G-J<br>(F-H)  | 110                              |
|  | Sb, Fa     | VR, R, W, MW & I  | A-F,<br>(A-E) | 65                               |
|  |            | P to VP           | G-J<br>(F-H)  | 55                               |
|  | Sw, Se     | VR, R, W, MW & I  | A-F,<br>(A-E) | 85                               |
|  |            | P to VP           | G-J<br>(F-H)  | 70                               |

TABLE 3.7 (Continued)

| Sub-region<br>(North of the North<br>Saskatchewan River) | Species        | Drainage<br>Class | Ecosite       | Minimum crop<br>tree height (cm) |
|--|----------------|-------------------|---------------|----------------------------------|
| Montane  | Pl, Pf, Li     | VR, R, W, MW & I  | A-E,<br>(A-F) | 105                              |
|  |                | P to VP           | F-G<br>(G)    | 95                               |
|  | Sb, Fa         | VR, R, W, MW & I  | A-E,<br>(A-F) | 55                               |
|  |                | P to VP           | F-G<br>(G)    | 45                               |
|  | Fd             | VR, R, W, MW & I  | A-E,<br>(A-F) | 35                               |
|  | Sw, Se         | VR, R, W, MW & I  | A-E,<br>(A-F) | 70                               |
|  |                | P to VP           | F-G<br>(G)    | 60                               |
|  |                |                   |               |                                  |
| Subalpine  | Pl, Pw, Li, La | VR, R, W, MW & I  | A-D,<br>(A-F) | 105                              |
|  |                | P to VP           | E-I,<br>(G-H) | 95                               |
|  | Sb, Fa         | VR, R, W, MW & I  | A-D,<br>(A-F) | 55                               |
|  |                | P to VP           | E-I,<br>(G-H) | 45                               |
|  | Sw, Se         | VR, R, W, MW & I  | A-D,<br>(A-F) | 70                               |
|  |                | P to VP           | E-I,<br>(G-H) | 60                               |
|  |                |                   |               |                                  |
|  |                |                   |               |                                  |

Table 3.7 (Continued)

| Sub-region<br>(South of the North<br>Saskatchewan River) | Species                   | Drainage<br>Class | Ecosite       | Minimum crop<br>tree height (cm) |
|--|---------------------------|-------------------|---------------|----------------------------------|
| Lower Foothills  | Pl, Li                    | VR, R, W, MW & I  | A-F<br>(A-E)  | 100                              |
|  |                           | P to VP           | G-J<br>(F-H)  | 85                               |
|  | Sb, Fa, Pb                | VR, R, W, MW & I  | A-F<br>(A-E)  | 55                               |
|  |                           | P to VP           | G-J<br>(F-H)  | 45                               |
|  | Sw                        | VR, R, W, MW & I  | A-F<br>(A-E)  | 75                               |
|  |                           | P to VP           | G-J<br>(F-H)  | 65                               |
| Upper Foothills  | Pl, Li                    | VR, R, W, MW & I  | A-F<br>(A-E)  | 80                               |
|  |                           | P to VP           | G-J<br>(F-H)  | 70                               |
|  | Sb, Fa                    | VR, R, W, MW & I  | A-F<br>(A-E)  | 55                               |
|  |                           | P to VP           | G-J<br>(F-H)  | 40                               |
|  | Sw, Se                    | VR, R, W, MW & I  | A-F<br>(A-E)  | 70                               |
|  |                           | P to VP           | G-J<br>(F-H)  | 60                               |
| Montane  | Pl, Pw, Pl, Lw            | VR, R, W, MW & I  | A-E<br>(A-F)  | 60                               |
|  |                           | P to VP           | F-G<br>(G)    | 55                               |
|  | Sb, Fa                    | VR, R, W, MW & I  | A-E<br>(A-F)  | 45                               |
|  |                           | P to VP           | F-G<br>(G)    | 35                               |
|  | Sw, Se                    | VR, R, W, MW & I  | A-E<br>(A-F)  | 65                               |
|  |                           | P to VP           | F-G<br>(G)    | 55                               |
|  | Fd                        | VR, R, W, MW & I  | A-E<br>(A-F)  | 35                               |
|  |                           |                   |               |                                  |
| Subalpine  | Pl, Pw, Pl, Li, La,<br>Lw | VR, R, W, MW & I  | A-D,<br>(A-F) | 60                               |
|  |                           | P to VP           | E-I<br>(G-H)  | 55                               |
|  | Sb, Fa                    | VR, R, W, MW & I  | A-D,<br>(A-F) | 45                               |
|  |                           | P to VP           | E-I<br>(G-H)  | 35                               |
|  | Sw, Se                    | VR, R, W, MW & I  | A-D,<br>(A-F) | 65                               |
|  |                           | P to VP           | E-I<br>(G-H)  | 55                               |
|  | Fd                        | VR, R, W, MW & I  | A-E<br>(A-F)  | 35                               |
|  |                           |                   |               |                                  |

Table 3.8 details the minimum **deciduous** height requirements for an acceptable crop tree on areas being reforested to a coniferous-deciduous standard.

TABLE 3.8  
Deciduous crop tree performance height requirements  
for areas being reforested to a coniferous-deciduous standard.

| Natural Sub-region                                  | Species    | Drainage Class   | Ecosite       | Minimum crop tree height (cm) |
|---|------------|------------------|---------------|-------------------------------|
| Central Mixedwood<br>Dry Mixedwood<br>Wet Mixedwood | Aw, Pb, Bw | VR, R, W, MW & I | A-E           | 200                           |
|   |            | P to VP          | F-H           | 150                           |
| Boreal Highlands                                    | Aw, Pb, Bw | VR, R, W, MW & I | A-E           | 200                           |
|   |            | P to VP          | F-G           | 150                           |
| Lower Foothills                                     | Aw, Pb, Bw | VR, R, W, MW & I | A-F,<br>(A-E) | 175                           |
|   |            | P to VP          | G-J,<br>(F-H) | 125                           |
| Upper Foothills                                     | Aw, Pb, Bw | VR, R, W, MW & I | A-F,<br>(A-E) | 150                           |
|   |            | P to VP          | G-J,<br>(F-H) | 115                           |
| Montane   | Aw, Pb, Bw | VR, R, W, MW & I | A-E,<br>(A-F) | 150                           |
|   |            | P to VP          | F-G,<br>(G)   | 115                           |
| Subalpine   | Aw, Pb, Bw | VR, R, W, MW & I | A-D,<br>(A-F) | 150                           |
|   |            | P to VP          | E-I,<br>(G-H) | 115                           |

### 3.3 Deciduous-Coniferous Standard (DC)

#### 3.3.1 Timing of Survey

The Performance Survey must be carried out no sooner than 8 years and no later than 14 years after harvesting is completed.

#### 3.3.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one acceptable crop tree which meets the species, height and other characteristics as defined below.

A cutblock being reforested to a deciduous-coniferous (DC) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 3.9:

TABLE 3.9

| Cutblock  | Minimum Conifer Stocking | Minimum Deciduous Stocking* | Minimum Total Cutblock Stocking |
|---|--------------------------|-----------------------------|---------------------------------|
| Areas harvested March 1, 1991 to April 30, 2000 | 30%                      | 30%                         | 80%                             |
| Areas harvested after May 1, 2000               | 30%                      | 50%                         | 80%                             |

\*The assessment of the minimum stocking of the deciduous species is independent of the presence of coniferous trees on the plot. Where both species groups are represented, this is referred to as an overlapping plot.

#### 3.3.3 Acceptable Crop Trees

Acceptable Free-to-Grow seedlings, performing deciduous trees, and acceptable Free-to-Grow advanced growth are considered acceptable crop trees.

An acceptable Free-to-Grow seedling is a tree of acceptable coniferous species which has achieved the minimum height requirement specified in Table 3.11, is alive, healthy and undamaged, and has grown on-site for a minimum of three years. In order to be considered Free-to-Grow, it must be located at least 1.5 to 2m distance from any deciduous tree (other than residual deciduous trees) which is taller than two-thirds its height or any shrub which is taller than two-thirds its height.

| Species                | Free-to-Grow Cylinder Size | Area within cylinder free of competitor trees  |
|------------------------|----------------------------|--|
| Spruces, larches, firs | 1.5 m radius               | Free of deciduous competitor trees/shrubs throughout a 270 degree arc around the crop tree |
| Pines                  | 2.0 m radius               | Free of deciduous competitor trees/shrubs within entire cylinder around the crop tree      |

A performing deciduous tree is a tree of acceptable species which has achieved the minimum height requirement specified in Table 3.12, is alive, healthy and undamaged, and has grown on-site for a minimum of three years. There is no requirement for a competition-free cylinder for the deciduous species.

**Acceptable Free-to-Grow advanced growth** is a specific tree of acceptable species which was established in advance of the harvest, meets the minimum height requirement and which also has the following characteristics:

1. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the established crop trees are harvested.
2. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base.
3. The tree originated from seed or suckering, but not from layering.
4. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.
5. The tree meets the species-specific definition of Free-to-Grow

### 3.3.3.1 Acceptable crop tree species

Table 3.10 details the crop tree species which are acceptable for established seedlings and advanced growth on areas being reforested to a deciduous-coniferous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Service.

TABLE 3.10  
Acceptable crop tree species including advanced growth  
for areas being reforested to a deciduous-coniferous standard.

| Coniferous species | Deciduous species     |
|--------------------|-----------------------|
| White spruce       | Trembling aspen       |
| Englemann spruce   | Balsam (Black) poplar |
| Black spruce       | Hybrid Poplar *       |
| Lodgepole pine     | White (Paper) birch   |
| Jack pine          |                       |
| Whitebark pine     |                       |
| Limber pine        |                       |
| Tamarack           |                       |
| Western larch      |                       |
| Alpine larch       |                       |
| Siberian larch*    |                       |
| Douglas-fir        |                       |

\* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP)

Balsam fir and Subalpine fir may be considered acceptable species for specific cutblocks when either:

- a. fir has been identified specifically in the DFMP and a management strategy has been developed for its use and expected yield; or
- b. fir has been identified as being a species in the overstory that was harvested. This would be applied on a block-by-block basis and must be presented in pre-harvest plans; or
- c. when approval is received from the Forest Area Manager to allow it to be used as an acceptable species for resource management objectives other than fibre production on a specific cutblock basis.

The amount of fir which is acceptable on a block by block basis is determined prior to the survey. Greater detail regarding acceptability of fir will be provided in directives posted or otherwise communicated by the Land and Forest Service.

### 3.3.3.2 Acceptable crop tree height

Table 3.11 details the minimum conifer performance height requirements for an acceptable crop tree on areas being reforested to a deciduous-coniferous standard.

TABLE 3.11  
Coniferous crop tree performance height requirements  
for areas being reforested to a deciduous-coniferous standard.

| Sub-region<br>(North of the North<br>Saskatchewan River) | Species    | Drainage<br>Class | Ecosite       | Minimum crop<br>tree height (cm) |
|--|------------|-------------------|---------------|----------------------------------|
| Central Mixedwood<br>Wetland Mixedwood<br>Dry Mixedwood  | Pl, Pj, Li | VR, R, W, MW & I  | A-E           | 150                              |
|  |            | P to VP           | F-H           | 130                              |
|  | Sb, Fa, Fb | VR, R, W, MW & I  | A-E           | 75                               |
|  |            | P to VP           | F-H           | 60                               |
|  | Sw         | VR, R, W, MW & I  | A-E           | 100                              |
|  |            | P to VP           | F-H           | 80                               |
| Lower Foothills  | Pl, Li     | VR, R, W, MW & I  | A-F<br>(A-E)  | 150                              |
|  |            | P to VP           | G-J<br>(F-H)  | 130                              |
|  | Sb, Fa, Fb | VR, R, W, MW & I  | A-F<br>(A-E)  | 75                               |
|  |            | P to VP           | G-J<br>(F-H)  | 60                               |
|  | Sw         | VR, R, W, MW & I  | A-F<br>(A-E)  | 100                              |
|  |            | P to VP           | G-J<br>(F-H)  | 80                               |
| Boreal Highlands   | Pl, Pj, Li | VR, R, W, MW & I  | A-E           | 150                              |
|  |            | P to VP           | F-G           | 130                              |
|  | Sb, Fa, Fb | VR, R, W, MW & I  | A-E           | 75                               |
|  |            | P to VP           | F-G           | 60                               |
|  | Sw         | VR, R, W, MW & I  | A-E           | 100                              |
|  |            | P to VP           | F-G           | 80                               |
| Upper Foothills  | Pl, Li     | VR, R, W, MW & I  | A-F,<br>(A-E) | 125                              |
|  |            | P to VP           | G-J<br>(F-H)  | 110                              |
|  | Sb, Fa     | VR, R, W, MW & I  | A-F,<br>(A-E) | 65                               |
|  |            | P to VP           | G-J<br>(F-H)  | 55                               |
|  | Sw, Se     | VR, R, W, MW & I  | A-F,<br>(A-E) | 85                               |
|  |            | P to VP           | G-J<br>(F-H)  | 70                               |



TABLE 3.11 (Continued)

| Sub-region<br>(North of the North<br>Saskatchewan River) | Species        | Drainage<br>Class | Ecosite       | Minimum crop<br>tree height (cm) |
|--|----------------|-------------------|---------------|----------------------------------|
| Montane  | Pl, Pf, Li     | VR, R, W, MW & I  | A-E,<br>(A-F) | 105                              |
|  |                | P to VP           | F-G<br>(G)    | 95                               |
|  | Sb, Fa         | VR, R, W, MW & I  | A-E,<br>(A-F) | 55                               |
|  |                | P to VP           | F-G<br>(G)    | 45                               |
|  | Fd             | VR, R, W, MW & I  | A-E,<br>(A-F) | 35                               |
|  | Sw, Se         | VR, R, W, MW & I  | A-E,<br>(A-F) | 70                               |
|  |                | P to VP           | F-G<br>(G)    | 60                               |
|  |                |                   |               |                                  |
| Subalpine  | Pl, Pw, Li, La | VR, R, W, MW & I  | A-D,<br>(A-F) | 105                              |
|  |                | P to VP           | E-I,<br>(G-H) | 95                               |
|  | Sb, Fa         | VR, R, W, MW & I  | A-D,<br>(A-F) | 55                               |
|  |                | P to VP           | E-I,<br>(G-H) | 45                               |
|  | Sw, Se         | VR, R, W, MW & I  | A-D,<br>(A-F) | 70                               |
|  |                | P to VP           | E-I,<br>(G-H) | 60                               |
|  |                |                   |               |                                  |
|  |                |                   |               |                                  |

### 3.4 Deciduous Standard (D)

#### 3.4.1 Timing of Survey

For areas satisfactorily restocked in the establishment survey there is no performance survey required to meet the deciduous performance standard. Conditionally restocked areas, however, are subject to a deciduous performance survey which must be carried out no sooner than 10 years and no later than 14 years after harvesting is completed.

#### 3.4.2 Stocking and Average Height

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one acceptable performing crop tree which meets the species, height and other limitations as defined below.

A cutblock that is to be reforested to a deciduous standard will be considered satisfactorily restocked when:

- 80% or more of the sample plots are stocked with at least one acceptable performing crop tree and a minimum of 60% of plots are stocked with deciduous crop trees, and
- the average height of acceptable deciduous trees for the area is greater than or equal to the average height of the deciduous trees by subregion and drainage class. (Table 3.14)

#### 3.4.3 Acceptable crop trees

##### 3.4.3.1 Acceptable crop tree species

Table 3.13 details the crop tree species which are acceptable for established seedlings and advanced growth on areas being reforested to a deciduous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Service.

TABLE 3.13

Acceptable crop tree species for areas being reforested to a deciduous standard.

| Coniferous species | Deciduous species     |
|--------------------|-----------------------|
| White spruce       | Trembling aspen       |
| Englemann spruce   | Balsam (Black) poplar |
| Black spruce       | Hybrid Poplar *       |
| Lodgepole pine     | White (Paper) birch   |
| Jack pine          |                       |
| Whitebark pine     |                       |
| Limber pine        |                       |
| Tamarack           |                       |
| Western larch      |                       |
| Alpine larch       |                       |
| Siberian larch*    |                       |
| Douglas-fir        |                       |

\* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP)

\*Balsam fir and Subalpine fir may be considered acceptable species for specific cutblocks when either:

- a. fir has been identified specifically in the DFMP and a management strategy has been developed for its use and expected yield; or
- b. fir has been identified as being a species in the overstory that was harvested. This would be applied on a block-by-block basis and must be presented in pre-harvest plans; or
- c. when approval is received from the Forest Area Manager to allow it to be used as an acceptable species for resource management objectives other than fibre production on a specific cutblock basis.

The amount of fir which is acceptable on a block by block basis is determined prior to the survey. Greater detail regarding acceptability of fir will be provided in directives posted or otherwise communicated by the Land and Forest Service.

#### **3.4.3.2     *Characteristics of acceptable crop trees***

An **acceptable crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement specified in Table 3.14, is alive, healthy and undamaged, and has grown on-site for a minimum of three years. Coniferous trees must not have more than two stems at the base.

### 3.4.3.3 Acceptable crop tree height

Table 3.14 provides the minimum heights for various species groups and sites as required to meet deciduous performance standards.

TABLE 3.14  
Crop tree height and average height requirements  
for areas being reforested to a deciduous performance standard.

| Natural Sub-region                                      | Species        | Drainage Class   | Ecosite       | Minimum crop tree height (cm) | Minimum average height of acceptable deciduous trees (cm) * |
|---|----------------|------------------|---------------|-------------------------------|---|
| Central Mixedwood<br>Wetland Mixedwood<br>Dry Mixedwood | Pl, Pj, Lt     | VR, R, W, MW & I | A-E           | 160                           | n/a   |
|   |                | P to VP          | F-H           | 160                           | n/a   |
|   | Sw, Sb, Fa, Fb | VR, R, W, MW & I | A-E           | 80                            | n/a   |
|   |                | P to VP          | F-H           | 80                            | n/a   |
|   | Aw, Pb, Bw     | VR, R, W, MW & I | A-E           | 200                           | 400   |
|   |                | P to VP          | F-H           | 200                           | 300   |
| Lower Foothills   | Pl, Lt         | VR, R, W, MW & I | A-F<br>(A-E)  | 160                           | n/a   |
|   |                | P to VP          | G-J<br>(F-H)  | 160                           | n/a   |
|   | Sw, Sb, Fa, Fb | VR, R, W, MW & I | A-F<br>(A-E)  | 80                            | n/a   |
|   |                | P to VP          | G-J<br>(F-H)  | 80                            | n/a   |
|   | Aw, Pb, Bw     | VR, R, W, MW & I | A-F<br>(A-E)  | 200                           | 350   |
|   |                | P to VP          | G-J<br>(F-H)  | 200                           | 250   |
| Boreal Highlands  | Pl, Pj, Lt     | VR, R, W, MW & I | A-E           | 160                           | n/a   |
|   |                | P to VP          | F-G           | 160                           | n/a   |
|   | Sw, Sb, Fa, Fb | VR, R, W, MW & I | A-E           | 80                            | n/a   |
|   |                | P to VP          | F-G           | 80                            | n/a   |
|   | Aw, Pb, Bw     | VR, R, W, MW & I | A-E           | 200                           | 400   |
|   |                | P to VP          | F-G           | 200                           | 300   |
| Upper Foothills   | Pl, Lt         | VR, R, W, MW & I | A-F,<br>(A-E) | 160                           | n/a   |
|   |                | P to VP          | G-J<br>(F-H)  | 160                           | n/a   |
|   | Sw, Sb, Fa     | VR, R, W, MW & I | A-F,<br>(A-E) | 80                            | n/a   |
|   |                | P to VP          | G-J<br>(F-H)  | 80                            | n/a   |
|   | Aw, Pb, Bw     | VR, R, W, MW & I | A-F,<br>(A-E) | 150                           | 250   |
|   |                | P to VP          | G-J<br>(F-H)  | 150                           | 190   |

TABLE 3.14 (Continued)

| Natural Sub-region | Species        | Drainage Class   | Ecosite    | Minimum crop tree height (cm) | Minimum average height of acceptable deciduous trees (cm) * |
|--------------------|----------------|------------------|------------|-------------------------------|---|
| Montane            | Pi, Pf, Li     | VR, R, W, MW & I | A-E, (A-F) | 160                           | n/a   |
|                    |                | P to VP          | F-G (G)    | 160                           | n/a   |
|                    | Sw, Sb, Fa, Fd | VR, R, W, MW & I | A-E, (A-F) | 80                            | n/a   |
|                    |                | P to VP          | F-G (G)    | 80                            | n/a   |
|                    | Aw, Pb, Bw     | VR, R, W, MW & I | A-E, (A-F) | 150                           | 250   |
|                    |                | P to VP          | F-G (G)    | 150                           | 190   |

\*The average height of acceptable deciduous trees is the arithmetic mean of the tallest deciduous tree from each plot in the cutblock stocked to deciduous species, excluding advanced growth and those plots contributing to the declared conifer stocking percentage.

Sites with poor or very poor drainage combined with low original stand density may, if approved by the Land and Forest Service prior to harvest, be reforested to a modified stocking standard (Wet, low density modifier). Approved wet, low density modifier cutblocks will be considered satisfactorily restocked when 50% or more of the sample plots are stocked with at least one acceptable established coniferous crop tree. The stocked plots must be distributed evenly over the sample area.

A cutblock is a candidate for the wet, low density modifier when:

- a. the original stand cover type indicated an A or B density and an ecosite assessment indicates poor drainage and poor nutrient level (P-VP) and poor nutrient level, or
- b. the original stand cover type indicated an A or B density and an ecosite assessment indicates very poor drainage (VP), and in either case
- c. treatment feasibility has been demonstrated.

Height requirements are the same as those described for C, CD, and DC standards. There is no wet, low density standard for deciduous (D) strata cutblocks.

## 5.0 Field Survey Procedures

In order to ensure that regeneration surveys are completed and reported consistently across Alberta, procedures and reporting forms are standardized. The regeneration survey information required is to be entered on the Regeneration Survey Tally Sheet, and the Regeneration Survey Map Sheet. The templates for these forms are available from Alberta Environment.

In this chapter the standardized methods for conducting surveys, completing the tally sheet, and drafting the field map are described.

### 5.1 Cutblock Survey Information

The cutblock survey description information on the upper left of the Regeneration Survey Tally Sheet, page 1 (see Appendix 9), identifies the cutblock and provides data needed to determine the standards on a per plot and cutblock basis. The following descriptions are provided to help explain what is required for each heading on the form:

#### 5.1.1 Cutblock description

|                                     |  |
|-------------------------------------|--|
| <b>Opening Number:</b>              | The official cutblock number used by Alberta Environment for record keeping. This number is assigned to the cutblock according to the legal location of the centre of the cutblock. The assigning of this number legitimizes the cutblock opening in the Provincial records and is mandatory.  |
| <b>Disposition:</b>                 | The FMA, licence, or permit number under which the cutblock was harvested.   |
| <b>Disposition Holder/Operator:</b> | The company responsible for reforestation  |
| <b>Year Cut:</b>                    | The year in which cutting was completed  |
| <b>Company Block Number:</b>        | A unique number used by the timber operator  |
| <b>Field Number:</b>                | Cutblock identifier common to company or LFS district assignment. Not as universal as the Opening Number.  |
| <b>Forest Area</b>                  | The LFS administrative unit.   |
| <b>FMU</b>                          | Forest Management Unit   |
| <b>Subregion:</b>                   | Alberta's forested areas are classified into geographical areas which exhibit similar natural forest vegetation. Enter the short version of the Natural subRegion.<br>CM Central Mixedwood<br>DM Dry Mixedwood<br>WM Wetland Mixedwood<br>BH Boreal Highland<br>LF Lower Foothills<br>UF Upper Foothills<br>SA Subalpine<br>MO Montane |
| <b>Ecosite:</b>                     | Within each subregion, cutblocks or portions of cutblocks can be classified into plant community types. This ecosite categorization will have been determined in the pre-harvest survey. Enter the ecosite code as in "E1.1".  |

|                          |  |
|--------------------------|--|
| <b>Drainage Class:</b>   | <p>Drainage assessments provides a standard method for assessing soil moisture conditions. Enter the code of the drainage class for the cutblock or the portion of the cutblock.</p> <p>VR Very rapid<br/>R Rapid<br/>W Well<br/>MW Moderately Well<br/>I Imperfectly<br/>P Poorly<br/>VP Very Poorly</p>  |
| <b>General Location:</b> | Because Natural subregions may extend great distances north and south, the regeneration system makes a separation using the North Saskatchewan River as the border. Circle either North or South in reference to the North Saskatchewan River  |
| <b>Strata Standard:</b>  | <p>This identifies the species mix which reforestation efforts are expected to produce, and hence the survey standard to be used. Check the square of the strata standard for the cutblock as it was originally classified.</p> <p>The operator may be allowed to re-classify the strata standard in certain situations. If this option has been exercised, a selection can be made under "re-classification".</p> <p>C Coniferous<br/>CD Coniferous/Deciduous mixedwood<br/>DC Deciduous/Coniferous mixedwood<br/>D Deciduous</p> |
| <b>Survey Type:</b>      | <p>Establishment<br/>Performance</p> <p>Wet, low density - note: this is a modifier and could apply to both establishment and performance surveys.</p> <p>1991 Survey - If the cutblock is not being surveyed to the 2000 Regeneration Survey Standards, it may have a high elevation or lowland modifier.</p>   |
| <b>Survey Grid:</b>      | <p>The survey grid is the selected line and plot spacing described in Section 4.1.4.</p> <p>•Line spacing is the distance between survey lines measured in metres to the nearest 0.1 meters.</p> <p>•Plot spacing is the distance between plots along the line measured in metres to the nearest 0.1 meters.</p>   |
| <b>Cutblock Area:</b>    | Area in hectares, commonly determined after harvesting using aerial photos, GPS unit or traverse of the perimeter.   |

### 5.1.2 Survey details

|                              |  |
|------------------------------|--|
| <b>Survey Date:</b>          | Day, month, and year of survey completion  |
| <b>Surveyed By:</b>          | Name of certified surveyor and other surveyors. Primary surveyor first, helpers second.                          |
| <b>Certification Number:</b> | Number assigned by Alberta Environment to the primary surveyor who has met the qualifications for certification. |



### 5.1.3 Determining the Number of Sample Plots Required

The number of plots required within the various sizes of cutblocks is shown in Table 5.1.

TABLE 5.1  
Sampling requirements for Establishment and Performance surveys.

| Block Size (Ha) | Number of Sample Plots Required  |
|-----------------|--|
| 0.1 - 1.9       | Minimum of 12.4 plots/ha   |
| 2.0 - 4.0       | Establish minimum of 41 plots/block or as many as needed to cover block. If stocking is in 73% - 79% range, intensify to 54 plots. |
| 4.1 - 24.0      | Establish minimum of 64 plots/block or as many as needed to cover block. If stocking is in 73% - 79% range, intensify to 84 plots. |
| > 24.0*         | 2.77 plots/ha  |

\*To determine the number of sample plots needed for cutblocks which are greater than 24 ha, simply multiply the gross block area by 2.77. Round the decimal up to the nearest whole number.

### 5.1.4 Calculating the Survey Grid (line and plot spacing)

#### Square spacing

The survey standard is a square grid pattern where the distance between lines equals the distance between plots. Once the total number of plots and the area of the block are known, the survey grid (plot and line spacing) can be calculated.

$$\text{Plot spacing} = \sqrt{\frac{\text{Cutblock Area (ha)} \times 10,000 \text{ (m}^2\text{/ha)}}{\text{Required \# plots}}}$$

Example:

For surveys on a 12.1 ha block; calculate a square survey grid.

1. A 12.1 ha block requires that 64 plots be established initially (Table 5.1)
2. Calculate the plot spacing:

$$\begin{aligned}\text{Plot spacing} &= \sqrt{\frac{\text{Cutblock Area (ha)} \times 10,000 \text{ (m}^2\text{/ha)}}{\text{Required \# plots}}} \\ &= \sqrt{\frac{12.1 \times 10,000}{64}} \\ &= \sqrt{1890.625} \\ &= 43.48\end{aligned}$$

3. Round off to the nearest 0.1 m:

line spacing = 43.5 m

plot spacing = 43.5 m

NOTE: Appendix 4 contains calculated square spacing distances for various cutblock sizes.

#### Rectangular spacing

Line spacing may differ from plot spacing provided the line spacing does not exceed twice the plot spacing. For cutblocks 24 ha and larger, a 60 m by 60 m square grid must be used.

In order to calculate rectangular spacing, one usually selects the desired line spacing, then calculates the plot spacing needed to achieve the correct number of plots.

#### Example:

For surveys on a 3.9 ha block; calculate a rectangular survey grid, assuming a line spacing of 35 m.

1. A 3.9 ha block requires that 41 plots be established initially (Table 3.1)

$$2. \text{ Plot spacing} \times \text{Line spacing} = \frac{\text{Cutblock Area (ha)} \times 10,000 \text{ (m}^2\text{/ha)}}{\text{Required \# plots}}$$

$$\text{Plot spacing} \times 35 \text{ m} = \frac{3.9 \text{ ha} \times 10,000 \text{ m}^2\text{/ha}}{41 \text{ plots}}$$

$$\text{Plot spacing} = \frac{951.22 \text{ m}^2}{35 \text{ m}}$$

$$\text{Plot spacing} = 27.1777 \text{ m}$$

3. Round off to the nearest 0.1 m:

line spacing = 35.0 m

plot spacing = 27.2 m

## 5.2 Field Layout

### 5.2.1 Control Lines and Survey Lines

For each area to be surveyed, control line (s) should be established for control of line and plot location as follows:

- Establish one control line that is parallel to the long axis of the cutblock. Where the cutblock width exceeds 400 m, establish additional lines parallel to the first at 400 metre intervals.
- The control line is usually placed in line with the grid so that points along the control line are used as plot centres. The control line(s) should be referenced to the cutblock boundary in order to be able to map the sample plot locations accurately. Starting from the cutblock edge, the first line is located at one-half the interline distance, and each additional survey line is marked at the exact line distance.
- Survey line intervals on the control line are to be double flagged, and the line and plot number clearly written on the flagging.
- All survey and control lines are to be compassed and measured using a tape or string measuring devise. All measured distances must be based on horizontal or surface projections.

### 5.2.2 Plot Layout

- Beginning at the control line, the individual plots are located by compass and distance measurement.
- The size of the sample plot shall be 1/1000 ha or 10 m<sup>2</sup>.
- The shape of the sample plot shall be circular and have a radius of 1.78 m; the centre of the circle and the plot centre shall be a common point.
- Every plot centre is to be clearly marked in the field. Mark plot centres with a stake firmly planted in the ground at the plot centre. Write the plot number and line number on a piece of flagging with a black, waterproof marker pen and then attach the flagging to the stick. Do not use grass, herbs or shrubs to indicate plot centres.
- Acceptable established crop trees (both coniferous and deciduous) must be marked with flagging in every plot to facilitate field checking.

### 5.2.3 Plots to Delete

When it is known at the start of the survey that an area must be deleted from the cutblock due to an active disposition or natural deletion, the grid is to be calculated based on the reduced cutblock area. As the grid is being surveyed in, any plot landing on the deletion should be deleted. If the area of the deletion is correct, the proper number of plots to fill the opening should be obtained without moving any plots.

Examples of dispositions to delete from the cutblock area are:

- MLL - Miscellaneous lease (campsite, sand and gravel, etc.)
- PLA - Pipeline Agreement
- LOC - Licence of Occupation Road
- Well site
- Archeological and historic sites
- Permanent sample plots or other research areas (in most cases)

Natural deletions to delete from the cutblock area are:

- Riparian areas and uncut buffers (no stumps encountered; 0.04 ha or larger)
- Uncut patches within the cutblock (no stumps encountered; 0.4 ha or larger)

#### 5.2.4 Plots to Move

While establishing plots, the surveyor may encounter a new disposition or natural deletion which will not be reforested and which had not been subtracted from the cutblock area at the time the grid was calculated. As a result, the grid may be set at a wider spacing than it should be in order to obtain the required number of plots. Therefore, when the disposition or unexpected deletion is encountered, the plot should be moved half the plot distance toward the next plot to help obtain the required number without adding plots later (see Section 5.2.5). If the plot still lands on the disposition, continue to move at one half the plot distance intervals until a plot can be established. The plot following a moved plot remains at its normal grid location.

Plots falling on temporarily flooded areas, brush piles, landings, in-block roads (without a disposition) will not be moved or deleted.

#### 5.2.5 Adding Plots

The minimum number of plots must be established (see Table 5.1). If additional plots are required to make up this minimum number, they should be spaced as follows:

- a. Halfway between every third survey line (i.e., halfway between and parallel to the third and fourth survey lines, sixth and seventh lines, etc.).
- b. Plot spacing should be the same on the additional lines as on the original lines to facilitate delineation of SR/NSR areas.
- c. If use of every third line is not enough to add all the plots needed, proceed to add lines between other survey lines until the desired number of plots is reached. Lines must be marked on the control line and numbered with a sequential numeral (no letters).

#### 5.2.6 Defining Ecosite and Site Drainage Classifications

All assessments of drainage class or ecosite classification will be conducted using site evaluation methods acceptable to the Forest Area Manager. The classification will be conducted on a block by block basis by personnel suitably trained and experienced. If the forest operator wishes to indicate discrete and mappable areas of the cutblock where drainage class differences occur, he must submit site evaluation information along with the regeneration surveys.

Proper ecosite classification requires evaluation of the undisturbed plant community types and therefore must be conducted prior to harvest. In the case of ecosite classification where the equivalent to P-VP drainage class is expected, the Forest Area Manager reserves the right to refuse the classification where a soil drainage assessment does not confirm the assumed moisture limitations for the ecosite.

#### Applicability

For D strata standard cutblocks cut after May 1, 1998, and for C, CD, and DC cutblocks cut after May 1, 2000, drainage or ecosite assessments conducted after harvest will not be accepted as just cause for modification to the classification (as defined by the VR to I drainage class by Natural subregion). For D cutblocks with reforestation zero year commencing after March 1, 1991 but before May 1, 1998, and for C, CD, and DC blocks with skid clearance after March 1, 1991 but before May 1, 2000, drainage class assessments contributing to the determination of cutblock status may be conducted up to the time of the establishment survey.

#### Stratification by ecosite or drainage class

Where cutblock areas are to be separated into discrete areas of differing drainage classes or ecosite classes, it is expected that these areas will be delineated and treated as separate cutblocks. For cutblocks with areas of differing drainage classes, where it is not desirable to treat these as separate cutblocks, the percentage of area for each drainage or ecosite class may be estimated.

For D cutblocks containing small, scattered areas of differing drainage or ecosite, the new cutblock minimum average height and minimum trees/plot requirements are calculated based on the respective percentages for each ecosite or drainage class.

For the C, CD, and DC strata standards, ecosite and drainage stratification will not be allowed unless the areas are mappable and are greater than 0.04 ha in size. The status for plots falling within P-VP drainage areas of less than 0.04 ha is assessed according to the standards for VR-I drainage classes.

### **5.3 Recording Plot Data on Tally Sheets**

Regeneration survey data shall be recorded for each plot on the Regeneration Survey Tally Sheet. The following briefly describes the standards for plot measurements and completion of the appropriate blanks on the tally sheet. Use of tally sheets other than the standard forms must be approved by the Forest Area Manager before surveying begins.

#### **5.3.1 Line and Plot Numbers**

Each plot is identified by numerical plot and line number. For lines added after the initial grid is applied, the line should be given the next number in the sequence, not a letter.

## 5.4 On-site Stocking Check

Before the regeneration surveyor leaves the cutblock, a check of the survey's statistical accuracy must be made. The details of the statistical accuracy standards are provided in Appendix 2, however the surveyor simply needs to confirm that, based on the calculated stocking percent, a sufficient number of valid sample plots have been established:

For cutblocks 2.0 to 4.0 ha in size, if stocking is in 73% - 79% range, 54 plots are required rather than the 41 that would be established initially.

For cutblocks 4.1 to 24.0 ha in size, if stocking is in 73% - 79% range, 84 plots are required rather than the 64 that would be established initially.

### 5.4.1 Recalculating the Regeneration Survey Area

The first step in ensuring there are enough plots is to confirm that the cutblock area is correct. The cutblock area may not always account for deletions of non-productive and non-forested areas within the perimeter. Use of a square survey grid with known distances between plots and lines permits an easy calculation of the cutblock area. The principle is that each plot location represents an area (in square metres) equal to the line spacing multiplied by the plot spacing. To calculate the regeneration survey area simply multiply the area represented by one plot by the number of plots located in the grid. Divide by 10,000 to convert from square metres to hectares.

Enter the calculated **Regen Survey Area** in the **Survey Results** box on the tally sheet.

$$\text{Regen survey area} = \frac{\text{line spacing} \times \text{plot spacing} \times \text{number of grid plots}}{10,000}$$

A **grid plot** is a non-deleted plot located on the predetermined plot and line spacing. Do not include plots that have been moved one-half the plot distance, unless the reason for the move was a temporary deletion. Do not include plots which have been deleted or ones which have been added to lines not on the original line spacing (i.e. between lines).

### 5.4.2 Preliminary Stocking Percent

In order to determine if the stocking falls in the 73% to 79% range, a preliminary stocking percent is needed. Using the *Stocking Summary* table on the back of the Map Sheet, a preliminary stocking percent is calculated as follows:

#### Establishment survey stocking

1. For each species group, count the number of **satisfactorily restocked plots (SR)**; multiply by 100 and then divide by the total number of **valid** plots established so far to get a percent for each species group. All plots which have not been deleted are considered **valid**.
2. Add the percent for each of the species group to arrive at the preliminary stocking percent to the nearest 0.1%. Include the percent for plots stocked with both established conifer and established deciduous in the total cutblock stocking percent, but do not count any plot more than once.

#### **Performance survey stocking**

1. For each species group, count the number of **Free-to-Grow plots (FTG)** and **deciduous (SR)**; multiply by 100 and then divide by the total number of **valid plots** established so far to get a percent for each species group. All plots which have not been deleted are considered valid.
2. Add the percent for each of the species group to arrive at the preliminary stocking percent to the nearest 0.1%. Include the percent for plots stocked with both FTG conifer and performing deciduous in the total cutblock stocking percent.

#### **5.4.3 Adding More Plots and Recalculating Stocking**

Using the preliminary stocking percent and the recalculated area (Regen Survey Area), refer to the Table 5.1 to determine the number of plots required. If for any reason more plots need to be established, follow the rules for adding plots as presented in Section 5.2.5.

**Ensure enough plots have been established prior to leaving the cutblock.**


#### **5.4.4 Damage, Site Conditions and Treatments Recommended**

On Page 2 of the map sheet, space is provided to record cutblock summary information. This data is optional, but may be very important for determining why a particular cutblock may have failed the survey. It will also help determine what remedial action (further tending, cleaning, etc.) is needed to meet the management objectives. Keep track of any physical damage, insect or disease damage that you observe on the crop trees or other trees in the plot and then report the extent of this damage on a cutblock basis using the table on page 2 of the map sheet.

## 5.5 Field Map Completion

Field maps should be drawn on the standard Field Map Sheet as the surveyor progresses through the cutblock. This will help the surveyor map certain features of the cutblock and the status of the plots surveyed. All maps submitted are to show the following information for each cutblock surveyed:


- Disposition and opening number.
- Cutblock boundaries.
- Total block area. Use survey grid to check on block area. Make corrections where necessary.
- North arrow.
- Location of control line(s) and tie point(s) for same.
- Location of survey lines and plots.
- Plot numbers and line numbers.
- The location and size of permanent deletions.
- Symbols for stocking status and species grouping for each plot (see symbols below)
- Scale of the map
- Delineation of NSR areas (See Section 6.1.1)


 - not cut or deleted plot


 - non-stocked (NSR)


 - undersized seedlings (NSR)

 - stocked with conifer (SR)


 - stocked with acceptable deciduous (SR)


 - stocked with conditional coniferous (deciduous survey only, 20% max.) (SR)

 - stocked with both acceptable coniferous and acceptable deciduous (SR)


 - undersized conifer (NSR)

 - undersized deciduous (NSR)

 - acceptable conifer, not Free-to-Grow (NSR)

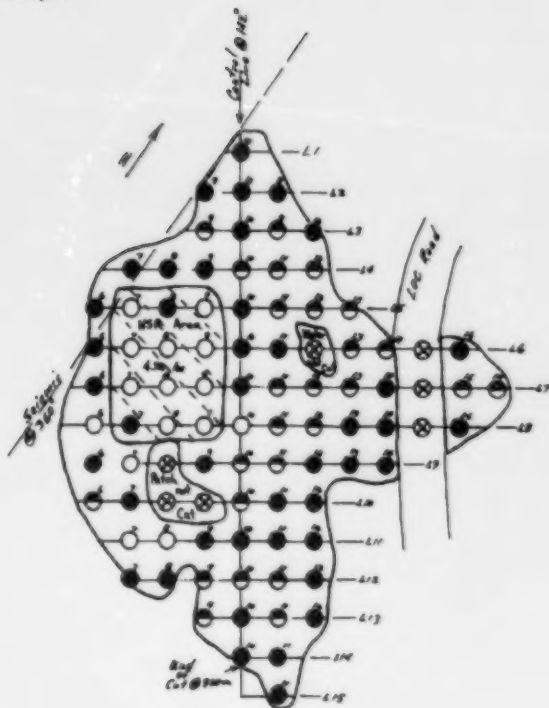
 - stocked with Free-to-Grow coniferous (FTG)

 - stocked with performing deciduous (SR)

 - stocked with both Free-to-Grow conifer and performing deciduous (FTG)



Example:



Disposition : CTL5030002  
 Opening Number : 0761040012  
 Scale : 1:5000  
 Block Area : 30.5 ha  
 Survey Date : May 1, 2000

## 6.0 Compilation and Survey Submission

### 6.1 Preparing the final map

The final map to be submitted to the Forest Area Manager must either be drawn on the Map Sheet or generated from a reliable computer program. If the field map and tally cards are neat and complete, they may be submitted, otherwise all information from field tally cards and field maps is to be transferred over to produce a neat, detailed drawing of the cutblock at a reasonable scale (preferably 1:5000). Ensure that all information required, as outlined in Section 5.5 of this manual, is on the map.

#### 6.1.1 Identifying Poor Stocking Distribution

In addition to plot locations and symbols, the map is to show:  
for an Establishment Survey:

1. The location and size of non-stocked areas larger than 2 ha within an otherwise SR cutblock

for a Performance Survey:

1. The location and size of non-Free-to-Grow areas larger than 2 ha within an otherwise Free-to-Grow cutblock

The process of delineation of 4 ha patches will be done using a moving average of plot status, checking in perpendicular and diagonal rows across the cutblock for areas which do not meet the required 80% stocking level or Free-to-Grow level. The following procedure can be used for both Establishment and Performance Surveys for stocking and Free-to-Grow area delineation:

1. Identifying unstocked areas within a generally stocked cutblock:
  - a. Starting at one corner of the block, proceed along the lines and examine five plots at a time. Five is considered the optimum number because four out of five stocked plots coincides with 80% stocking. After the first five plots have been examined, drop the first plot in the line and add one plot on the end (running average of five plots). Continue progressing to the end of the line until the last five plots have been checked.
  - b. A section of five plots is called stocked if four of the plots are stocked. All stocked plots are considered regardless of conifer or deciduous status. A section of five plots is called unstocked if it contains zero to three stocked plots. If there are fewer than five plots in a line, all plots must be stocked in order to call the whole line stocked. If there are more than five plots in a line, the beginning of the first unstocked five-plot section and the end of the last unstocked five-plot section should be marked to select the unstocked portion of a line (see Appendix 5 for an example).
  - c. After each line is checked and marked, the marked areas should be joined to show the boundaries of the suspected unstocked areas. The same procedure is to be repeated by running the five-plot, moving average perpendicular to the first direction. An area shown to be NSR in both directions shall be considered the NSR area requiring treatment.

2. Identifying stocked areas within a generally unstocked block:

The procedure is the same as for identifying unstocked areas in a stocked block, except a five plot section is considered stocked only when all the plots are stocked. This means 100% stocking. The procedure described above should not be used to delineate SR/NSR patches that are smaller than 4 ha, and there should be a minimum of 10 plots in the sub-unit. This restriction is necessary because if the number of plots is very small, there is a high probability that the area will be classified incorrectly.

3. Procedure for Wet, Low Density survey standard:

The stocking requirement for wet, low density surveys is 50% rather than the 80% on standard establishment and performance surveys. The procedure is the same as above, except that instead of a five plot running average, a four plot average is used. A section of four plots is called stocked if two or more of the plots are stocked.

Some logical adjustments may be made around the border of the NSR area. When the above procedure has been completed, calculate the area of each NSR patch to determine if any of these are greater than 4 ha. Unstocked portions of stocked blocks greater than 4 ha will require reforestation treatment and must be shown on the final map that is submitted to the Forest Area Manager.

Unstocked areas between 2 and 4 ha in size are to be mapped in a manner acceptable to the Forest Area Manager. Areas under LOC are exempt from this procedure.

The area of an NSR patch is to be entered in the "Survey Results" area on the first page of the regeneration survey tally sheet.

### 6.1.2 Roads and Landings Exceeding 5% of Cutblock Area

Compacted areas resulting from roads and landings often regenerate poorly. These areas are to be mapped during the regeneration survey when the area exceeds 5% of the total cutblock area, in a manner acceptable to the Forest Area Manager. While there is no direct effect on the stocking status of the cutblock when the area exceeds 5%, the cutblock is to be included in a population of cutblocks to be analyzed at the time of the next timber supply analysis to ensure that the effect of roads and landings is addressed. Areas under LOC are exempted because they are withdrawn from the cutblock area.

The area covered by roads and landings is to be entered in the "Survey Results" area on the first page of the regeneration survey tally sheet.

## 6.2 Calculating the cutblock stocking percent and cutblock status

### 6.2.1 Cutblock Stocking Percent

Once any additional plots have been entered (Section 5.4.3), and the individual plot status has been recorded on the tally sheets, the cutblock stocking can be calculated using Page 2 of the Map Sheet. The procedure for calculating cutblock stocking percent is the same as outlined in Section 5.4.2.

The final cutblock stocking percent is to be entered in the "Survey Results" area on the first page of the regeneration survey tally sheet.

### **6.2.2 Cutblock Status**

There are three requirements for achieving a Satisfactorily Restocked status (Establishment) or a Free-to-Grow status (Performance) for the cutblock:

- The cutblock stocking percent must be 80% or more, unless the cutblock is a wet, low density modifier block where the minimum is 50%, and
- The minimum stocking percentages for deciduous and coniferous must be met, and
- The minimum average density and minimum average deciduous crop tree height must be met (for D standard)

Using the appropriate section in the manual, determine whether the cutblock is Conditionally Restocked (COND), Satisfactorily Restocked (SR), Free-to-Grow (FTG), or Not Satisfactorily Restocked (NSR).

The final cutblock status is to be entered in the "Survey Results" area on the first page of the regeneration survey tally sheet.

## **6.4 Submitting survey forms and digital files**

Regeneration surveys completed by the disposition holder must be submitted to the Forest Area Manager by October 30 of the year in which they are due.

### **6.4.1 Paper Submission to the Forest Area Manager**

An acceptable submission for each cutblock contains:

1. Tally sheets and final map with delineation of NSR patches greater than 2 ha and roads/landings where their area is greater than 5% of the cutblock area. These should be contained in one package.
2. Stocking percentages, block status and other survey results data as shown on the front of the Regeneration Survey Tally Sheet (page 1) and on the final map.

### **6.4.2 Electronic Data Submission.**

An acceptable submission for each cutblock includes a properly named data file(s) presented in a format acceptable to Alberta Environment containing:

1. A printable survey map of the cutblock showing any NSR areas >2 ha and roads/landings where their area is greater than 5% of the cutblock area, and
2. Individual plot and tree data, and
3. Summary data compiled for the cutblock.

Further detail on this procedure will be contained in policy directives posted or otherwise communicated by Alberta Environment.

## 7.0 Survey Quality

To ensure that regeneration surveys are performed in an accurate and complete manner, Land and Forest Service may undertake a program of check surveys. Any check survey must be carried out by a certified surveyor. The check survey is to be conducted simultaneously with the original survey or, where this is not feasible, during the period that the industry surveyors are still actively carrying out survey work in the same locality.

### Plot-on-Plot Check Regeneration Surveys

For forest industry surveys carried out by certified surveyors, the check survey method used will be the "plot-on-plot" method. Approximately 10% of the total blocks surveyed in a given area will be chosen at random and a minimum of 25 plots will be carefully checked in each block. At the start of the season, one block of the first five blocks should be checked for each surveyor.

A demerit system is used to recognize the relative importance of various infractions or inadequacies. A maximum of four demerit points will normally be allowed before a survey is rejected. Details of criteria for demerit points are itemized following. If the checker assesses more than four demerits before checking all 25 plots the survey fails and the checker need not continue with the survey check in that cutblock.

If, for example, 40 blocks have been regeneration surveyed, then at least four blocks (10%) would be check surveyed and 25+ plots in each of these blocks would be carefully checked. If the regeneration survey is found to be below standard during a check survey, the entire survey of blocks in a given area may be rejected based on the judgement of the check surveyor with concurrence of the Forest Area Manager.

### Criteria for Rejection of Surveys

Deductions are as follows:

- a. One demerit for each missed established seedling or sapling.
- b. One demerit for tallying an unacceptable established seedling or sapling; e.g., advance growth that should not have been tallied, dead leaders on seedlings, unhealthy seedling, more than two multiple stems, layered, damaged seedlings.
- c. One and one half demerits for tallying a tree that is outside the plot.
- d. One demerit for incorrectly identifying species; e.g., calling balsam fir a spruce, etc.
- e. Half demerit for inaccurate plot establishment. Ten percent error is allowed in plot spacing and line spacing.
- f. Half demerit for not tying into the control line.
- g. Half demerit for incorrect delineation of NSR areas.
- h. Half demerit for incorrect numbering of plots or lines.
- i. Half demerit for incorrect stocking grid pattern and/or incorrect map symbols.
- j. Half demerit for not correctly marking plot centers in the field.
- k. Half demerit for inaccurate density estimate or not recording density of trees on the plot. Variance to be  $\pm 2$  trees if total less than 10 trees or  $\pm 10\%$  if estimated total greater than 10 trees.
- l. One demerit for poor mapping quality. This will also include missed information on final map.

- m. One demerit for inaccurate crop tree height or diameter measurement. Height should be to the nearest cm and should be taken from the root collar to the top of the farthest reaching needle on the highest reaching leader or branch. Diameter should be measured at the root collar and recorded to the nearest millimetre (0.1cm).

#### **Rejection of a Block Survey**

- a. More than four (4) demerit marks will normally constitute grounds for rejection of a cutblock.
- b. Considering the seriousness of including seedlings from outside the plot boundary, two such errors will constitute grounds for rejection of the cutblock.

Rejection of two survey cutblocks would constitute grounds for rejection of all cutblocks surveyed by that particular surveyor. Obviously, the total number of cutblocks involved must be considered with respect to the number of cutblocks failed. The final decision in the matter is the responsibility of the Forest Area Manager.

The recourse for the surveyor, if a survey is rejected or if certification is suspended, is to meet with the Forest Area Manager to clarify the reasons, and find out what further options may be available to resolve any disagreements.

## 8.0 Acknowledgements

This manual was produced based upon the hard work and dedication of the Regeneration Survey Task Force members, whose research and forethought is advancing Alberta's silvicultural successes into the new millennium. The following individuals were active in the task force during the time when the essentials of the manual were being developed:

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| Gordon Giles     | Land and Forest Service - Secretary   |

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| Rory Thompson    | Land and Forest Service      |

## Appendix 1

### Glossary

|                       |   |
|-----------------------|---|
| Acceptable:           | A seedling or advance growth tree which meets all the requirements of species, age, form, height and health.  |
| Advance growth:       | A tree that was established in advance of the harvest and which meets all the standards for acceptability.  |
| Arithmetic mean:      | The average obtained by dividing the sum of the items by the number of individual items.  |
| Competitor:           | A deciduous tree or woody shrub that is equal to or taller than two-thirds of the height of a crop tree and is growing within a specified distance of a potential coniferous crop tree.   |
| Conditional seedling: | A coniferous tree on a deciduous establishment survey which does not meet the height requirements but does meet the other requirements of age, form, and health.  |
| Coniferous:           | Needle-leaved trees which produce cones, (includes larch spp.).   |
| Control line:         | A line established at 400 m intervals for control of plot location. The control line runs across the long axis of the cutblock and is marked at points where survey lines cross it.   |
| Crop tree:            | A crop tree is the tallest tree on the plot that has achieved the minimum height requirements as defined in the standards for the type of survey and the tree species and also meets the definition of an established tree.                                     |
| Deciduous:            | Broad leaved tree species which lose their leaves in the fall.  |
| Demerit:              | Demerits are deductions given as a result of errors committed when performing a regeneration survey and are determined by the check survey. More than four (4) demerit marks will normally constitute grounds for rejection of a cutblock.                      |
| Density:              | The number of trees on the plot which are over 30 cm height. The density for survey purposes is usually expressed as trees per plot. The average density for each species is the sum of the trees recorded on every plot, divided by the total number of plots. |
| DFMP:                 | Detailed forest management plan prepared by the timber operator.  |
| Disposition:          | The legal document that provides the timber rights to the disposition holder.   |
| Forest Area           | A geographic administrative unit within a Region of Alberta   |



|                               |   |
|-------------------------------|---|
| <b>Drainage class:</b>        | Actual water content in excess of field moisture capacity, and the extent during which such excess water is present in the plant rooting zone. Seven classes are provided, ranging from very rapidly to very poorly drained.                  |
| <b>Established Seedling:</b>  | A naturally established, healthy seedling or sapling, or a healthy, planted tree which has grown on the site for a minimum of three years.  |
| <b>Establishment:</b>         | The Establishment Survey is the first survey required after harvesting.   |
| <b>Field number:</b>          | The number assigned to a cutblock and which normally appears on the AOP map or harvest plan map.  |
| <b>FMA:</b>                   | Forest Management Agreement   |
| <b>FMU:</b>                   | Forest Management Unit  |
| <b>Free-to-Grow:</b>          | A crop tree which has achieved the minimum height requirements and is free of competitor trees and shrubs as defined in the standards for the type of survey and the tree species.  |
| <b>Horizontal projection:</b> | A flat view of the ground that is corrected for the additional land area created by topographic features.   |
| <b>Hybrid:</b>                | The offspring of two plants of different varieties. They are the result of tree improvement programs to improve the growth or other characteristics of the native varieties.  |
| <b>Leader:</b>                | The top growth on a seedling which results from the current or past one year growth.  |
| <b>Natural Sub-region:</b>    | A geographic area, containing sites with similar characteristics, and defined by plant species composition and abundance of reference ecosites.   |
| <b>NSR:</b>                   | Not satisfactorily restocked according to the definitions described in the Regeneration Survey Manual for the type of survey, species, height, etc. The term may refer to an individual plot, a portion of a cutblock, or an entire cutblock. |
| <b>Opening number:</b>        | A unique number assigned to a cutblock based on the legal location of the center of the harvested area (stand opening).   |
| <b>Overlapping plot:</b>      | A plot which contains both an acceptable coniferous tree and an acceptable deciduous tree.  |

## Appendix 3

### Number of Sample Plots Required

The total number of plots required to sample any given area can be calculated using the formula:

$$n = 40,000 \sqrt{\frac{p \cdot q}{E^2}}$$

Where:  $n$  = number of sample plots to be established

$p$  = proportion of plots stocked expressed as a decimal

$q = 1 - p$ ; proportion of plots unstocked expressed as a decimal

$E$  = maximum allowable sampling error, which must not exceed:

+/- 10.0% for cutblocks larger than 4 ha, or

+/- 12.5% for cutblocks 2 - 4 ha where the stocking result indicated by the survey is 80% or more

The values of  $p$  and  $q$  are not known for the area prior to the survey, so an assumed stocking value of 80% is to be used.

| CUTBLOCK SIZE:       | SAMPLE PLOTS:   |
|----------------------|---|
| 0.1 - 1.9 ha ----->  | min. 12.4 plots/ha  |
| 2.0 - 4.0 ha ----->  | initially 41 plots/cutblock<br>41 plots: If stocking 0-72% or 80-100%<br>54 plots: If stocking 73-79% |
| 4.1 - 24.0 ha -----> | initially 64 plots/cutblock<br>64 plots: If stocking 0-72% or 80-100%<br>84 plots: If stocking 73-79% |
| 24.0 ha + ----->     | min. 2.77 plots/ha  |

## Appendix 4

### Line and Plot Spacing

Survey Line and Sample Plot Spacing

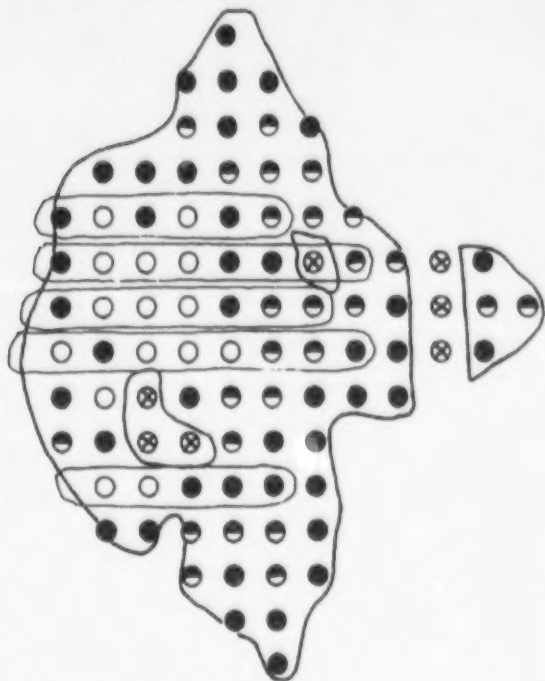
| Hectares | Square Metres<br>per plot | Square<br>Spacing<br>in Metres | Plots/Ha | Allowable<br>Error | Number of<br>Plots |
|----------|---------------------------|--------------------------------|----------|--------------------|--------------------|
| 0.5      | 806.45                    | 28.40                          | 12.40    | 32.66              | 6                  |
| 1.0      | 806.45                    | 28.40                          | 12.40    | 22.19              | 12                 |
| 1.5      | 806.45                    | 28.40                          | 12.40    | 18.35              | 19                 |
| 2.0      | 487.80                    | 22.09                          | 20.50    | 12.50              | 41                 |
| 2.5      | 609.76                    | 24.69                          | 16.40    | 12.50              | 41                 |
| 3.0      | 731.71                    | 27.05                          | 13.67    | 12.50              | 41                 |
| 3.5      | 853.66                    | 29.22                          | 11.71    | 12.50              | 41                 |
| 4.0      | 975.61                    | 31.23                          | 10.25    | 12.50              | 41                 |
| 4.5      | 703.13                    | 26.52                          | 14.22    | 10.00              | 64                 |
| 5.0      | 781.25                    | 27.95                          | 12.80    | 10.00              | 64                 |
| 5.5      | 859.38                    | 29.32                          | 11.64    | 10.00              | 64                 |
| 6.0      | 937.50                    | 30.62                          | 10.67    | 10.00              | 64                 |
| 6.5      | 1015.63                   | 31.87                          | 9.85     | 10.00              | 64                 |
| 7.0      | 1093.75                   | 33.07                          | 9.14     | 10.00              | 64                 |
| 7.5      | 1171.88                   | 34.23                          | 8.53     | 10.00              | 64                 |
| 8.0      | 1250.00                   | 35.36                          | 8.00     | 10.00              | 64                 |
| 8.5      | 1328.13                   | 36.44                          | 7.53     | 10.00              | 64                 |
| 9.0      | 1406.25                   | 37.50                          | 7.11     | 10.00              | 64                 |
| 9.5      | 1484.38                   | 38.53                          | 6.74     | 10.00              | 64                 |
| 10.0     | 1562.50                   | 39.53                          | 6.40     | 10.00              | 64                 |
| 10.5     | 1640.63                   | 40.50                          | 6.10     | 10.00              | 64                 |
| 11.0     | 1718.75                   | 41.46                          | 5.82     | 10.00              | 64                 |
| 11.5     | 1796.88                   | 42.39                          | 5.57     | 10.00              | 64                 |
| 12.0     | 1875.00                   | 43.30                          | 5.33     | 10.00              | 64                 |
| 12.5     | 1953.15                   | 44.19                          | 5.12     | 10.00              | 64                 |
| 13.0     | 2031.25                   | 45.07                          | 4.92     | 10.00              | 64                 |
| 13.5     | 2109.38                   | 45.93                          | 4.74     | 10.00              | 64                 |
| 14.0     | 2187.50                   | 46.77                          | 4.57     | 10.00              | 64                 |
| 14.5     | 2265.63                   | 47.60                          | 4.41     | 10.00              | 64                 |
| 15.0     | 2343.75                   | 48.41                          | 4.27     | 10.00              | 64                 |
| 15.5     | 2421.88                   | 49.21                          | 4.13     | 10.00              | 64                 |
| 16.0     | 2500.00                   | 50.00                          | 4.00     | 10.00              | 64                 |
| 16.5     | 2578.13                   | 50.78                          | 3.88     | 10.00              | 64                 |
| 17.0     | 2656.25                   | 51.54                          | 3.76     | 10.00              | 64                 |
| 17.5     | 2734.38                   | 52.29                          | 3.66     | 10.00              | 64                 |
| 18.0     | 2812.50                   | 53.03                          | 3.56     | 10.00              | 64                 |
| 18.5     | 2890.63                   | 53.76                          | 3.46     | 10.00              | 64                 |
| 19.0     | 2968.75                   | 54.49                          | 3.37     | 10.00              | 64                 |
| 19.5     | 3046.88                   | 55.20                          | 3.28     | 10.00              | 64                 |
| 20.0     | 3125.00                   | 55.90                          | 3.20     | 10.00              | 64                 |

| Hectares | Square Metres<br>per plot | Square<br>Spacing<br>in Metres | Plots/Ha | Allowable<br>Error | Number of<br>Plots |
|----------|---------------------------|--------------------------------|----------|--------------------|--------------------|
| 20.5     | 3203.13                   | 56.60                          | 3.12     | 10.00              | 64                 |
| 21.0     | 3281.25                   | 57.28                          | 3.05     | 10.00              | 64                 |
| 21.5     | 3359.38                   | 57.96                          | 2.98     | 10.00              | 64                 |
| 22.0     | 3437.50                   | 58.63                          | 2.91     | 10.00              | 64                 |
| 22.5     | 3515.63                   | 59.29                          | 2.84     | 10.00              | 64                 |
| 23.0     | 3593.75                   | 59.95                          | 2.78     | 10.00              | 64                 |
| 23.5     | 3671.88                   | 60.60                          | 2.72     | 10.00              | 64                 |
| 24.0     | 3750.00                   | 61.24                          | 2.67     | 10.00              | 64                 |
| 24.5     | 3610.11                   | 60.08                          | 2.77     | 9.71               | 68                 |
| 25.0     | 3610.11                   | 60.08                          | 2.77     | 9.61               | 69                 |
| 25.5     | 3610.11                   | 60.08                          | 2.77     | 9.52               | 71                 |
| 26.0     | 3610.11                   | 60.08                          | 2.77     | 9.43               | 72                 |
| 26.5     | 3610.11                   | 60.08                          | 2.77     | 9.34               | 73                 |
| 27.0     | 3610.11                   | 60.08                          | 2.77     | 9.25               | 75                 |
| 27.5     | 3610.11                   | 60.08                          | 2.77     | 9.17               | 76                 |
| 28.0     | 3610.11                   | 60.08                          | 2.77     | 9.08               | 78                 |
| 28.5     | 3610.11                   | 60.08                          | 2.77     | 9.00               | 79                 |
| 29.0     | 3610.11                   | 60.08                          | 2.77     | 8.93               | 80                 |
| 29.5     | 3610.11                   | 60.08                          | 2.77     | 8.85               | 82                 |
| 30.0     | 3610.11                   | 60.08                          | 2.77     | 8.78               | 83                 |
| 30.5     | 3610.11                   | 60.08                          | 2.77     | 8.70               | 84                 |
| 31.0     | 3610.11                   | 60.08                          | 2.77     | 8.63               | 86                 |
| 31.5     | 3610.11                   | 60.08                          | 2.77     | 8.56               | 87                 |
| 32.0     | 3610.11                   | 60.08                          | 2.77     | 8.50               | 89                 |
| 32.5     | 3610.11                   | 60.08                          | 2.77     | 8.43               | 90                 |
| 33.0     | 3610.11                   | 60.08                          | 2.77     | 8.37               | 91                 |
| 33.5     | 3610.11                   | 60.08                          | 2.77     | 8.30               | 93                 |
| 34.0     | 3610.11                   | 60.08                          | 2.77     | 8.24               | 94                 |
| 34.5     | 3610.11                   | 60.08                          | 2.77     | 8.18               | 96                 |
| 35.0     | 3610.11                   | 60.08                          | 2.77     | 8.12               | 97                 |
| 35.5     | 3610.11                   | 60.08                          | 2.77     | 8.07               | 98                 |
| 36.0     | 3610.11                   | 60.08                          | 2.77     | 8.01               | 100                |
| 36.5     | 3610.11                   | 60.08                          | 2.77     | 7.96               | 101                |
| 37.0     | 3610.11                   | 60.08                          | 2.77     | 7.90               | 102                |
| 37.5     | 3610.11                   | 60.08                          | 2.77     | 7.85               | 104                |
| 38.0     | 3610.11                   | 60.08                          | 2.77     | 7.80               | 105                |
| 38.5     | 3610.11                   | 60.08                          | 2.77     | 7.75               | 107                |
| 39.0     | 3610.11                   | 60.08                          | 2.77     | 7.70               | 108                |
| 39.5     | 3610.11                   | 60.08                          | 2.77     | 7.65               | 109                |
| 40.0     | 3610.11                   | 60.08                          | 2.77     | 7.60               | 111                |
| 40.5     | 3610.11                   | 60.08                          | 2.77     | 7.55               | 112                |
| 41.0     | 3610.11                   | 60.08                          | 2.77     | 7.51               | 114                |
| 41.5     | 3610.11                   | 60.08                          | 2.77     | 7.46               | 115                |
| 42.0     | 3610.11                   | 60.08                          | 2.77     | 7.42               | 116                |

| Hectares | Square Metres<br>per plot | Square<br>Spacing<br>in Metres | Plots/Ha | Allowable<br>Error | Number of<br>Plots |
|----------|---------------------------|--------------------------------|----------|--------------------|--------------------|
| 42.5     | 3610.11                   | 60.08                          | 2.77     | 7.37               | 118                |
| 43.0     | 3610.11                   | 60.08                          | 2.77     | 7.33               | 119                |
| 43.5     | 3610.11                   | 60.08                          | 2.77     | 7.29               | 120                |
| 44.0     | 3610.11                   | 60.08                          | 2.77     | 7.25               | 122                |
| 44.5     | 3610.11                   | 60.08                          | 2.77     | 7.21               | 123                |
| 45.0     | 3610.11                   | 60.08                          | 2.77     | 7.17               | 125                |
| 45.5     | 3610.11                   | 60.08                          | 2.77     | 7.13               | 126                |
| 46.0     | 3610.11                   | 60.08                          | 2.77     | 7.09               | 127                |
| 46.5     | 3610.11                   | 60.08                          | 2.77     | 7.05               | 129                |
| 47.0     | 3610.11                   | 60.08                          | 2.77     | 7.01               | 130                |
| 47.5     | 3610.11                   | 60.08                          | 2.77     | 6.97               | 132                |
| 48.0     | 3610.11                   | 60.08                          | 2.77     | 6.94               | 133                |
| 48.5     | 3610.11                   | 60.08                          | 2.77     | 6.90               | 134                |
| 49.0     | 3610.11                   | 60.08                          | 2.77     | 6.87               | 136                |
| 49.5     | 3610.11                   | 60.08                          | 2.77     | 6.83               | 137                |
| 50.0     | 3610.11                   | 60.08                          | 2.77     | 6.80               | 138                |

## Appendix 5

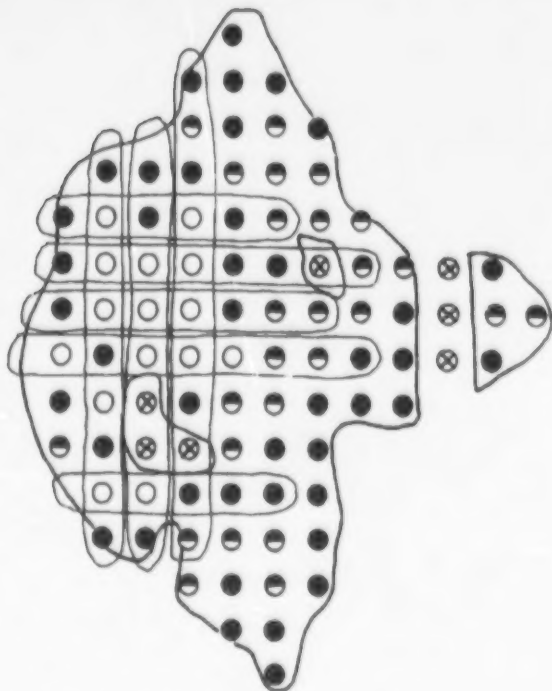
### *Delineating NSR areas larger than 2 ha (examples)*



Step 1: Example of west to east delineation  
of suspected NSR area

#### CD - ESTABLISHMENT SURVEY

|                  |   |               |          |
|------------------|---|---------------|----------|
| Block Area       | - | 30.5ha        |          |
| Valid Plots      | - | 84 plots      |          |
| Grid 60 x 60m    | - | 0.36ha/plot   |          |
| NSR              | - | 15 plots      |          |
| SR-Coniferous    | - | 43 plots / 84 | = 51.19% |
| SR-Deciduous     | - | 26 plots / 84 | = 30.95% |
| Stocking Percent | - |               | = 82.14% |

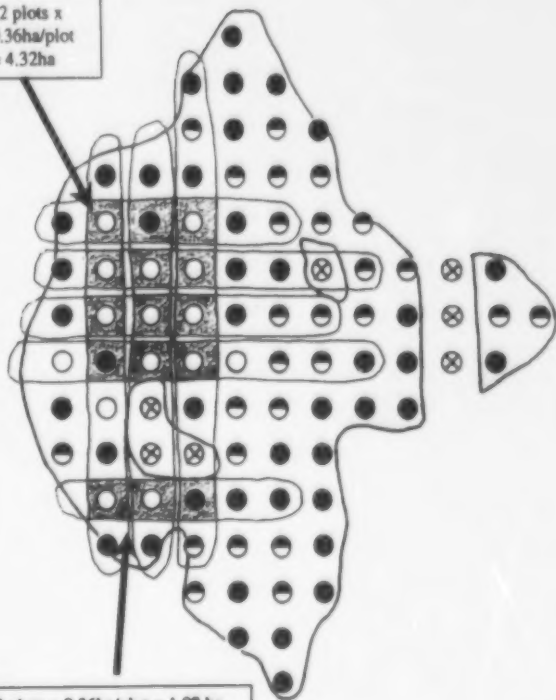


Step 2: North to south delineation of suspected NSR area

#### CD - ESTABLISHMENT SURVEY

|                  |                 |          |
|------------------|-----------------|----------|
| Block Area       | - 30.5ha        |          |
| Valid Plots      | - 84 plots      |          |
| Grid 60 x 60m    | - 0.36ha/plot   |          |
| NSR              | - 15 plots      |          |
| SR-Coniferous    | - 43 plots / 84 | = 51.19% |
| SR-Deciduous     | - 26 plots / 84 | = 30.95% |
| Stocking Percent |                 | = 82.14% |

12 plots x  
0.36ha/plot  
= 4.32ha



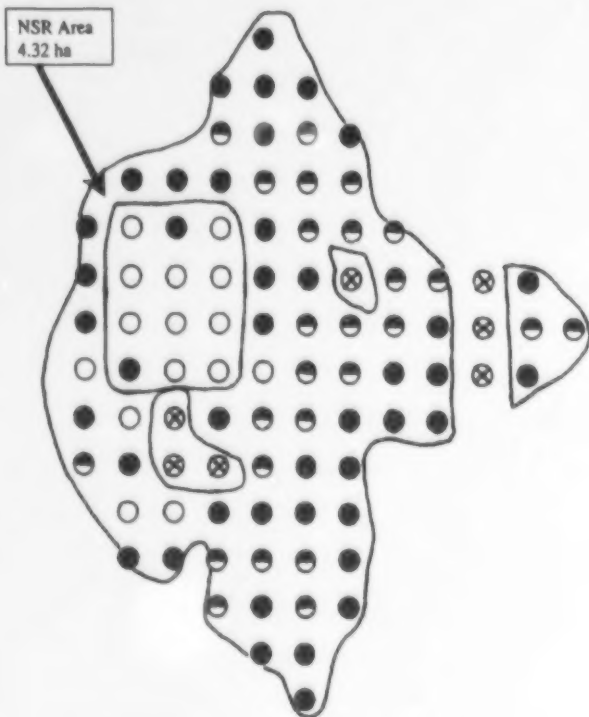
3 plots x 0.36ha/plot = 1.08 ha

Step 3. Overlapping area following east-west and north-south delineation of suspected NSR area.

#### CD - ESTABLISHMENT SURVEY

|                  |   |               |          |
|------------------|---|---------------|----------|
| Block Area       | - | 30.5ha        |          |
| Valid Plots      | - | 84 plots      |          |
| Grid 60 x 60m    | - | 0.36ha/plot   |          |
| NSR              | - | 15 plots      |          |
| SR-Coniferous    | - | 43 plots / 84 | = 51.19% |
| SR-Deciduous     | - | 26 plots / 84 | = 30.95% |
| Stocking Percent | - |               | = 82.14% |





Step 4. NSR area greater than 4.0 ha identified on cutblock map.

#### CD - ESTABLISHMENT SURVEY

|                  |   |               |          |
|------------------|---|---------------|----------|
| Block Area       | - | 30.5ha        |          |
| Valid Plots      | - | 84 plots      |          |
| Grid 60 x 60m    | - | 0.36ha/plot   |          |
| NSR              | - | 15 plots      |          |
| SR-Coniferous    | - | 43 plots / 84 | = 51.19% |
| SR-Deciduous     | - | 26 plots / 84 | = 30.95% |
| Stocking Percent | - |               | = 82.14% |

## Appendix 6

### Species Symbol Table

| COMMON NAME           | SPECIES SYMBOL |
|-----------------------|----------------|
| White spruce          | Sw             |
| Black spruce          | Sb             |
| Englemann Spruce      | Se             |
| Lodgepole pine        | Pl             |
| Jack pine             | Pj             |
| Whitebark pine        | Pw             |
| Limber pine           | Pf             |
| Tamarack              | Lt             |
| Alpine larch          | La             |
| Western larch         | Lw             |
| Siberian larch        | Ls             |
| Douglas-fir           | Fd             |
| Balsam fir            | Fb             |
| Alpine fir            | Fa             |
| Trembling aspen       | Aw             |
| Balsam (Black) poplar | Pb             |
| White birch           | Bw             |
| Hybrid poplar         | Ax             |

## Appendix 7

### Species Identification

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#### *Picea glauca*

White spruce

Leaves: Needle-shaped, four-sided, 2-3 cm long, straight, stiff, sharp pointed, bluish-green, aromatic when crushed.



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#### *Picea engelmannii*

Engelmann spruce

Leaves: Broad needle-shaped, about 2 cm long, stiff, blunt or sharp pointed, curved, four-sided in cross-section, bluish-green but often with a whitish bloom; aromatic when crushed; a strong tendency to point towards the upper side and end of the twig.

Twigs: More or less hairy, grayish to light brown; outer bud-scales shorter than the bud, not usually projecting beyond its tip.



---

#### *Picea mariana*

Black spruce

Leaves: Needle-shaped, four-sided, 1-2 cm long, straight, thick, stiff, blunt, bluish green in color.

Twigs: Hairy, brown

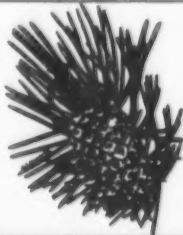


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#### *Pinus contorta* v. *latifolia*

Lodgepole pine

Leaves: Needle-shaped in bundles of 2, 2.5-8 long, spirally twisted, stiff, very sharp pointed, yellowish-green, forms dense cluster towards the end of twigs.



---

*Pinus banksiana*

Jack pine

**Size:** In closed stands on favourable sites, it reaches 27 m in height, with a straight trunk 60 cm. in diameter but, normally, it is 14-20 m in height and 20-30 cm in diameter.

**Leaves:** Pointed, light, yellowish-green, spread apart, the edges toothed; clusters with persistent basal sheaths.



---

*Pinus albicoulis*

Whitebark pine

**Leaves:** In 5's, 4-9 cm long, needle-shaped, stout, stiff, slightly curved, bluish-green, the edges not toothed, clustered towards the ends of the branchlets.

**Twigs:** Stout, tough, usually hairy, reddish-brown to chalky-white; buds oval, sharp pointed, with overlapping loose scales.



---

*Pinus flexilis*

Limber pine

**Leaves:** In 5's, 4-9 cm long, needle-shaped, stout, stiff, slightly curved, bluish-green, the edges not toothed, clustered towards the ends of the branchlets.

**Twigs:** Stout, tough, at first hairy, later smooth; greenish-yellow becoming gray; buds oval, pointed, with overlapping loose scales.



---

*Larix laricina*

Tamarack

**Leaves:** Needle-shaped in feather-like clusters of 10-20, 2-4 cm long, soft, flexible, pale green turning bright yellow in autumn. Sheds leaves in autumn.



*Pseudotsuga mensietee*

Douglas-Fir

Leaves: Linear, 2-3 cm long, often sharp pointed, soft, bright yellowish-green, paler below, standing out from three sides of the twig and appearing two-ranked.

Twigs: Slender, flexible; buds conical, sharp pointed, shiny reddish-brown.



*Abies balsamea*

Balsam fir

Leaves: Needle-shaped, flattened, 2-3 cm long, bent upward, rounded or blunt tipped, dark shiny green surface and whitish underside.



*Abies lasiocarpa*

Alpine fir

Leaves: Grayish-green to pale bluish-green above and below, with many markings (stomata) on both surfaces, 2-4 cm long, rounded or notched at the tip, curved upwards to stand almost erect along the twig, crowded, seldom two-ranked; resin canals in the internal tissue as viewed in the cross-section of the leaf.

Twigs: Stout, hairy, brownish, becoming grayish but retaining the hairiness usually for several years; buds 0.5 cm long, rounded and covered with wax-like resin.



*Populus tremuloides*

Trembling aspen, white aspen

Leaves: Alternate simple, rounded, abruptly pointed at tip, 4-6 cm wide. Teeth on margin fine, irregular, rounded. Leaf stem slender, flattened, usually longer than the leaf-blade, shiny deep green on top, paler under.





## Page 1

|                                     |               |    |     |     |
|-------------------------------------|---------------|----|-----|-----|
| Survey Results:                     | Total Pins:   |    |     |     |
| Regen Survey Area:                  |               |    |     |     |
| Culbstock Stacking %:               | Overall:      |    |     |     |
|                                     | % Coniferous: |    |     |     |
|                                     | % Deciduous:  |    |     |     |
| Average deciduous crop tree height: |               |    |     |     |
| Avg. susceptible deciduous (cm/yr): |               |    |     |     |
| Culbstock Status:                   | CODE          | SR | FTG | HSR |
| Swam Standard:                      | C             | CD | DC  | D   |
| HSR Area (ha):                      | SR Area (ha): |    |     |     |
| Reads & Landings Area (ha):         |               |    | %   |     |

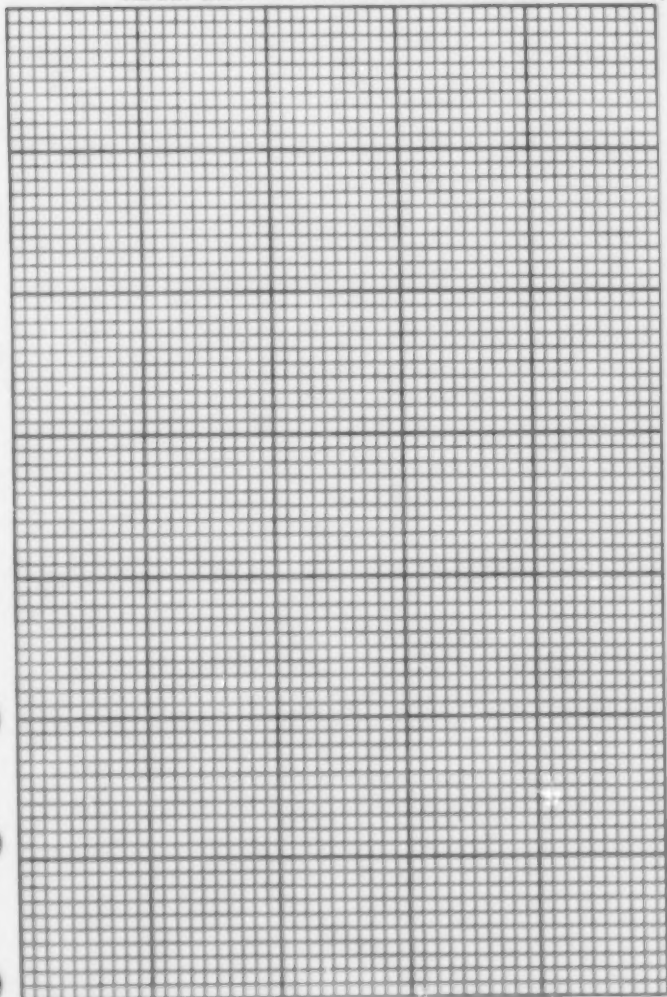
[illegible]





# REGENERATION SURVEY FIELD MAP

Map Sheet Page 1



|                       |                       |                     |
|-----------------------|-----------------------|---------------------|
| Opening Number: _____ | Company Number: _____ | Field Number: _____ |
| Scale: _____          | NSR Area: _____       | SRI Area: _____     |

# REGENERATION SURVEY SUMMARY














Map Sheet Page 2

Damage: Insect % Extent \_\_\_\_\_ Comments \_\_\_\_\_  
 Disease % Extent \_\_\_\_\_ Comments \_\_\_\_\_  
 Hare/Rodent % Extent \_\_\_\_\_ Comments \_\_\_\_\_  
 Other (specify % Extent) \_\_\_\_\_ Comments \_\_\_\_\_

Site Conditions: \_\_\_\_\_

Treatments Recommended: \_\_\_\_\_

Comments: \_\_\_\_\_

|                       |  | Tally Sheet | # of valid plot | Percent (%) |
|-----------------------|--|-------------|-----------------|-------------|
| All Surveys           |  - not cut or deleted plot  | NA          |                 |             |
|                       |  - non-stocked (NSR)  | NSR         |                 |             |
| Establishment Surveys |  - underseeded seedlings (NSR)  | UC / UD     |                 |             |
|                       |  - stocked with conifer, (SR)   | C           |                 |             |
|                       |  - stocked with acceptable deciduous (SR)                             | D           |                 |             |
|                       |  - stocked with conditional conifer (SR) (deciduous survey only)      | CC          |                 |             |
|                       |  - stocked with both acceptable conifer and acceptable deciduous (SR) | C & D       |                 |             |
| Performance Surveys   |  - underseeded conifer (NSR)  | UC          |                 |             |
|                       |  - underseeded deciduous - not performing (NSR)                       | UD          |                 |             |
|                       |  - acceptable conifer - NOT Free-to-Grow (NSR)                        | CT          |                 |             |
|                       |  - stocked with Free-to-Grow conifer (FTG)                            | C           |                 |             |
|                       |  - stocked with performing deciduous (SR)                           | D           |                 |             |
|                       |  - stocked with both FTG conifer and performing deciduous (FTG)     | C & D       |                 |             |
|                       | Total:   |             | plots           | %           |

% Coniferous \_\_\_\_\_

% Deciduous \_\_\_\_\_

|                                |                              |                                     |                          |
|--------------------------------|------------------------------|-------------------------------------|--------------------------|
| Culbstock Stocking Status:     |                              | Average deciduous height: _____     |                          |
| <input type="checkbox"/> COND. | <input type="checkbox"/> FTG | Average deciduous transplant: _____ |                          |
| <input type="checkbox"/> SR    | <input type="checkbox"/> NSR |                                     |                          |
| Tree Species Abbreviations:    |                              |                                     |                          |
| Sw - White spruce              | Pj - Jack pine               | Lw - Western Larch                  | Aw - Trembling aspen     |
| Se - Engelmann spruce          | Pw - Whitebark pine          | Le - Siberian larch                 | Pb - Balsam poplar       |
| Sl - Black spruce              | Pf - Limber Pine             | Pb - Balsam fir                     | Bw - White birch         |
| Pl - Lodgepole pine            | Lt - Tamarack                | Fd - Douglas Fir                    | SH - Shrub (competition) |
|                                | La - Alpine larch            | Pa - Alpine fir                     | As - Hybrid Poplar       |